3rd International Conference
ðResearch & Innovation in Engineering ð
COMAT 2014
16-17 October 2014, Braşov, Romania

# INFLUENCE OF THE MOVEMENT OF AGRICULTURAL MACHINERY OVER SOIL COMPACTION BY THE ACTION OF TIRES

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***Abstract.*** *The paper present the contact surfaces between tyre and soil, of the pressure on the soil in the contact surface, and of the deformation depth of the soil, depending on wheel load, tyre constructive elements, air pressure in the tyres and traffic intensity..*
***Keywords :*** *diameter, width, wheels, track*

## 1. INTRODUCTION

Residual soil deformation under the action of wheel running process depends on wheel load, operating and design parameters of tire type and condition of the soil

## 2. MATERIAL AND METHODS

Influence of dynamic wheel load on the maximum deformation of the soil on a sandy soil in a wheel equipped with tire 18.4-34 different tire pressures is shown in Figure 1 obtained by experimental data [1]. In the bottom right of the graph are plotted the tire width variations of soil deformation under different dynamic loads on the wheel. From the analysis graphs that soil residual deformation increases with increasing dynamic load, the increase being more pronounced at lower loads. Pa air pressure in the tire has a direct influence on both soil deformation at the interface between the wheel and the ground and ball. The increase in air pressure in the tire leads to an increase in pressure in the soil induced medium, since the tire deforms less. due to the rigidity of the case. It follows that the air pressure in the tire is a very important parameter and the same is a complex parameter.

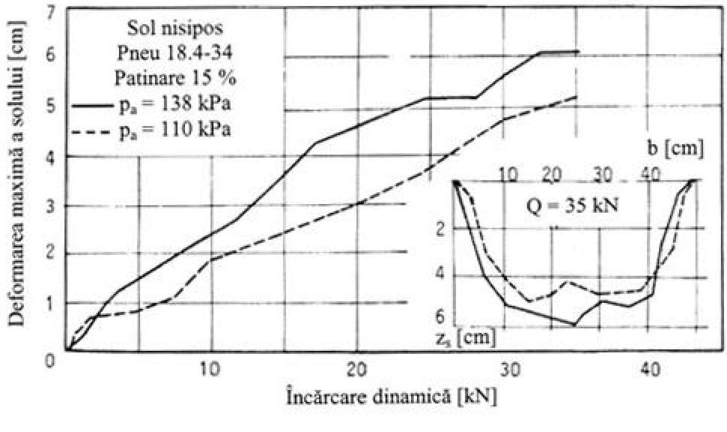

**Figure. 1.** Influence of dynamic wheel load on the maximum deformation of soil on a sandy soil in a wheel equipped with tire 18.4-34 different tire pressures:

Tire sizes fitted wheels have maximum influence on soil deformation and deformation across the width of the wheel of soil layers under the wheel charged with various tasks. Figure 2 Experimental data obtained on soil residual strain variation depending on load wheels equipped with different types of tires to travel on sandy soils [1]. In the bottom right of the graph are plotted the variations of soil deformation by tire width for dynamic load wheel equipped with tire 18.4-34.

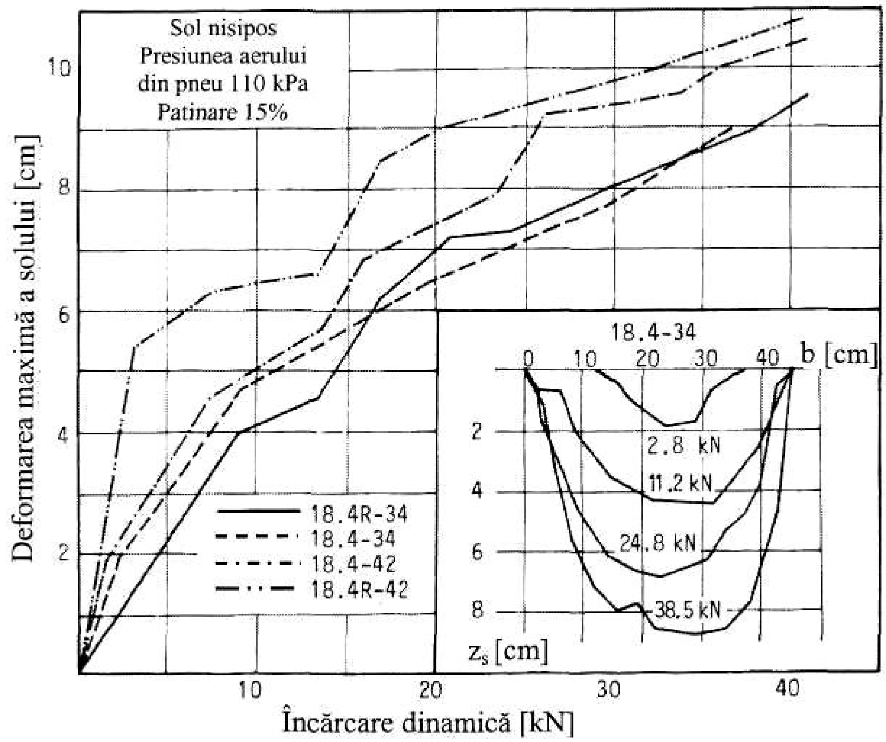


**Figure**. 2. Variation of maximum deformation of the soil by dynamic loads on wheels fitted with tires of different sizes.

Figure 3 shows the effect of the construction of the housing (bias and radial) tire when the tire 18.4-42 equipped with on the maximum deformation of the soil by the action the dynamic loads on the wheel. It is noted that in the case of radial of tires the maximum deflection of the soil is reduced due to the elasticity of the contact surface by increasing the deformation of the radial of tires carcass higher compared with the diagonal.

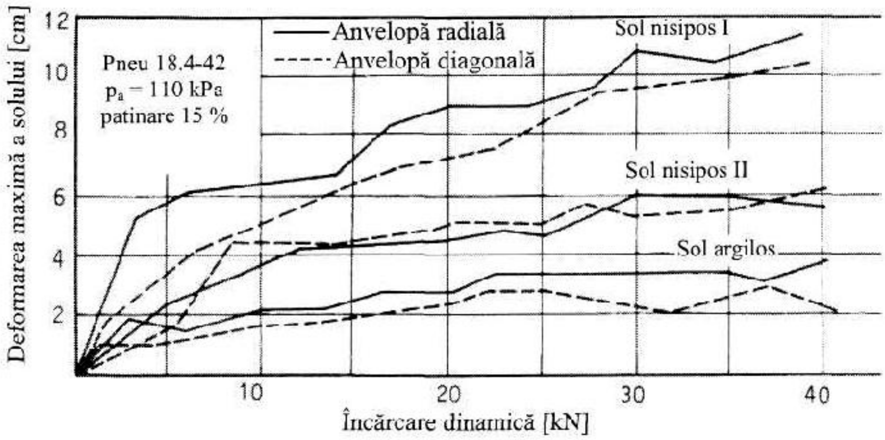


**Figure 3**. The influence of the tire carcass construction on the maximum deformation of soil p different dynamic wheel loads.

Ground deformation amount by wheels of tractors is influenced by the wheel spin. As is apparent from the experimental curves given in Figure 4 [1] Soil deformation increases with the size of the tire slip. Ground deformation is due only in vertical loading but loading in the horizontal plane due to the phenomenon of "slip-deformation", which occurs at the interface between the wheel and the ground.

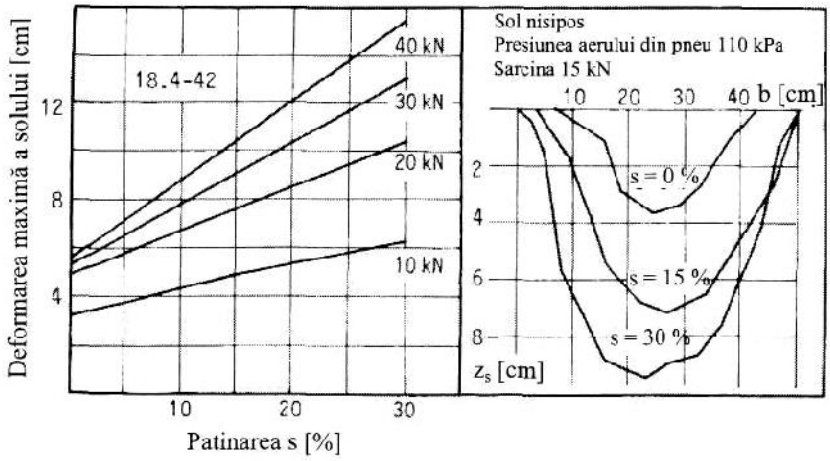


**Figure 4**. The influence of the slip on the maximum deformation of the soil**.**

The combined effect of the load on the wheel and the speed of movement on the all the depth shown in Figure 5 [2]. Thus it can be seen that the depth of the deflection of the soil is proportional to the load on the wheel and inversely proportional to the speed.
Compaction (compression) in the upper soil is estimated by the bulk density. Compacting in layers deeper issue, it is the task of loading the tires

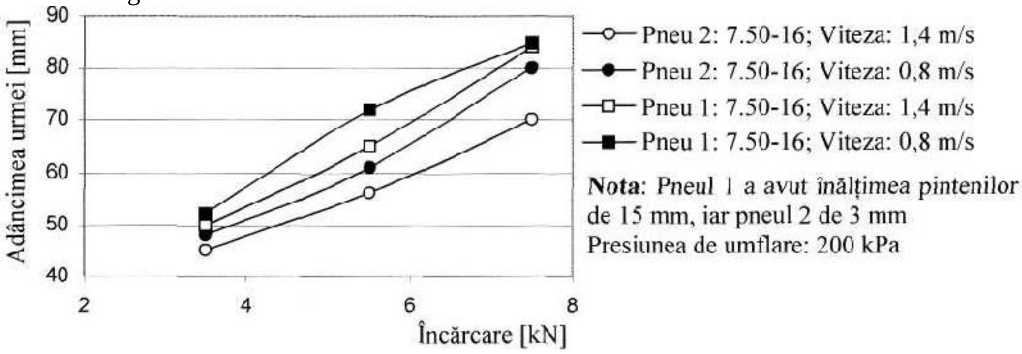


**Figure** *5.* Influence of wheel load and travel speed on the all depth.

Figure 6 shows the influence of pressure inside the bulk density of a loamy soil at different depths for a 18.4R38 tire loading of 3000 kg [3]. Loose soil initially had a density of about 1.32 kg / cm 3 and after passage of the wheels and the compaction density at a depth of 25 cm increased to a value of 1.6 kg / dm 3 to 0.4 bar internal pressure, reaching an amount of 1.7 kg / dm 3 to 1.8 bar internal pressure. This highlights the variation in soil density by internal pressure.

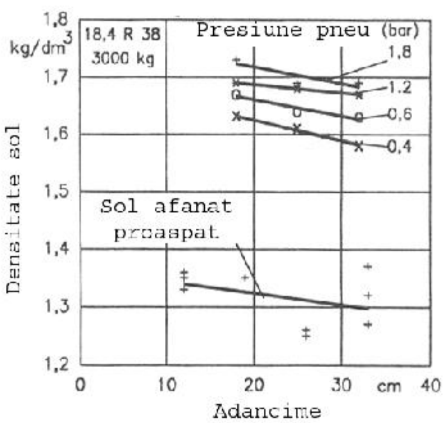

**Figure** *6. Soil bulk density dependence of internal pressure in the tire for different depths at the same tire load (18.4R38).*

The bulk density of the soil depends on the tire pressure. Figure 7 shows the variation in soil bulk density depending on tire pressure when the wheels fitted with tires 18.4 R 38 loaded on different tasks [4]. When the wheel load of 2700 kg load, by reducing the air pressure at 1.6 bar (the travel path) to 0.6 bar (offset field) loamy soils compacted to the bulk density of only 1, 6 kg / dm 3 and not 1.65 kg / dm 3. It is noted that the production of crops on the soil soil also depends on the soil density, reaching a maximum at a density of 1.5 kg / dm 3. It follows that by using a tire inner pressure of 1.6 bar to obtain maximum yields of 86%, on the other hand at a pressure of 0.6 bar to obtain maximum yields of 92% of the maximum attainable (ie an increase of 6 %).

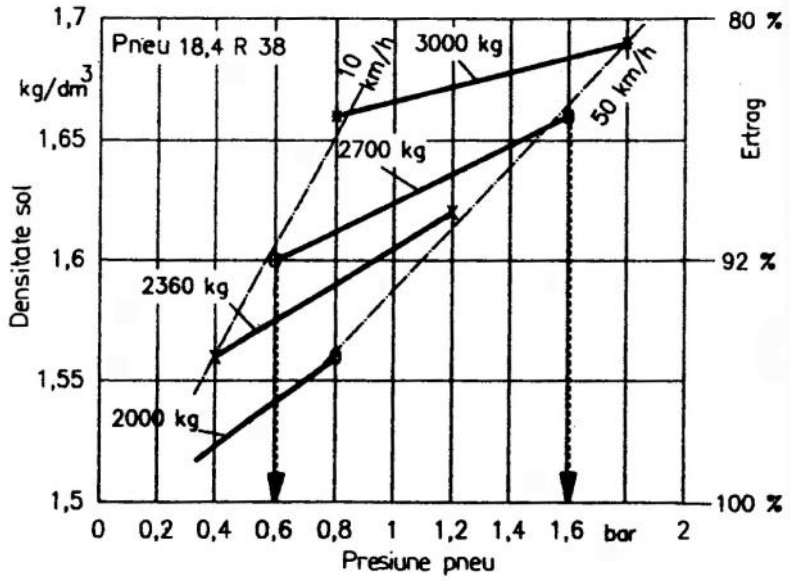


**Figure 7** *Variation of bulk density loamy soil at a depth of 25 cm depending on the tire internal pressure loading 18.4 R38 tire rated for different speeds.*

If tires are involved (if the drive wheels) soil bulk density increases with wheel spin value (fig. 8) [4]. Thus, at a tire load of 2670 kg load 18.4R38 the bulk density increases from 1.6 kg / dm 3 to move without slipping to a value of 1.75 kg / dm 3 to a slip of 60%. It follows that the reduced spin reduce tire pressure has a significant advantage on the bulk density decrease.

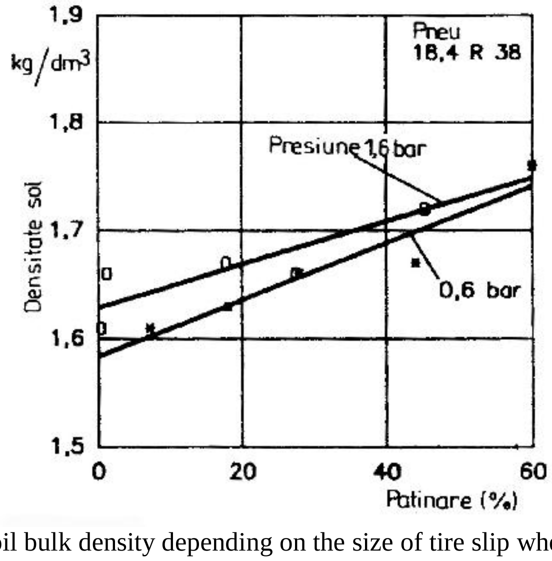


**Figure 8**. Changes in soil bulk density depending on the size of tire slip wheels with tires 18.4 R 38.

For experimental testing a drive wheel with 2760 kg load for a tire 520 / 70R 38 by slipping on a wet loamy soil 15.2% at a depth of 25 cm for two in tire pressure: 40 kPa and observed respectively 130 kPa. (Fig. 9). Initial bulk density of the soil was 1.13 ... 1.23 kg / dm 3. The analysis chart that soil bulk density increases with the wheel spin and tire air pressure decreases.

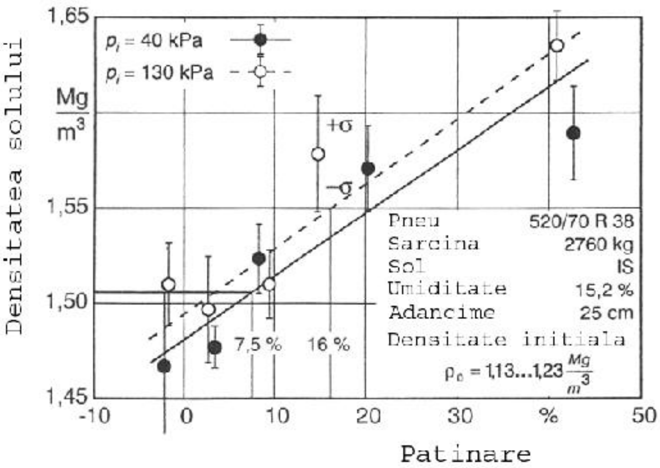


**Figure *9.*** Density dependence of soil (to a depth of 25 cm) to spin wheels of tractors for low pressure (40 kPa) and high pressure (140 kPa) of air in the tires.

Effect of soil compaction on the penetration resistance size depends on the number of passes behind the wheels on the same air pressure in the tire and wheel load. Tyres with reduced inflation pressure lower risk of soil compaction compared to higher pressure tires.

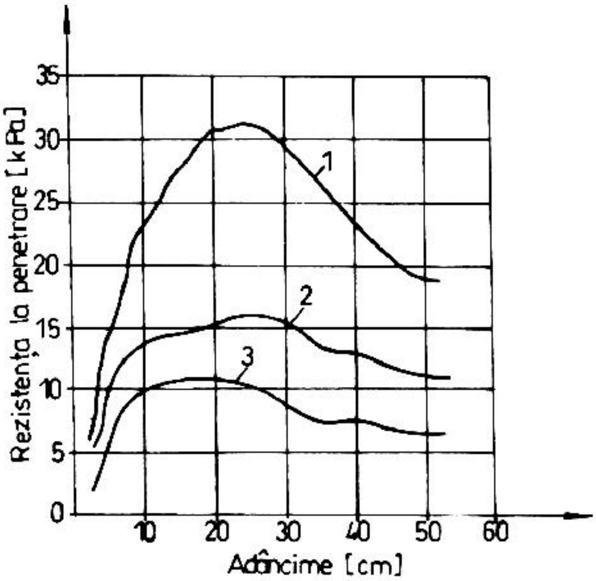


**Figure** *10.* The variation of the ground resistance depending on the penetration depth of penetration and kind of tires by the driving system of the tractor:
1 tire width (balonaj) low and high internal pressure; 2 Wheel width (balonaj) high and low internal pressure; 3 tires with low internal pressure and reduced load on the wheel.

For tractors with tires widths and large interior tire pressure and heavy duty wheels produces a strong compaction (compaction) of the soil, that increases resistance to penetration (fig. 10) [5,6], which achieves a maximum depth of 20 ... 30 cm, after which it begins to decrease (curve 1). The use of large-sized tires and low inflation pressure (curve 2), the penetration resistance of the soil is reduced by about 50% as compared to the use of wide of tires the lower and higher internal pressures (curve 1). If while reducing internal pressure decreases and wheel load (curve 3), the reduced resistance to penetration is deeper. Experiments have shown, however, that reduce soil compaction by reducing the load on the wheel is less obvious than that obtained by reducing tire pressure.

## 3. CONCLUSION

The size of the contact surface between the tire and the surface of the support depends on the tire size (diameter and baloon), the internal pressure of the tire and the concrete conditions of constant displacement load tire roţilor., contact area increases with decreasing pressure. Reduce the area of contact between the wheels and the ground is generally achieved by increasing the contact surface, a process that can be achieved by the following methods: the use of low tire pressure, tire fitting wheel tractors with large width or wheel double use of special low-pressure tires. Maximum pressure of the tire and the ground contact surface occurs. The effect of the load weighing on the wheel is the layer of soil under the ground tire pressure application to the three-dimensional spread in vertical direction (producing a compaction process, the compaction of soil) in the longitudinal direction (the shearing process of the soil) and laterally (soil discharge process).

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ACKNOWLEDGEMENT: This paper is supported by the Sectoral Operational Programme Human Resources Development (SOP HRD), financed from the European Social Fund andby the Romanian Government under the project number POSDRU/159/1.5/S/134378.