
THE INFLUENCE INFLATION PRESSURE IN THE TIRES ON SOIL COMPACTION

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ABSTRACT

In this article gives the influence of inflation pressure in the tires on soil compaction. In field-laboratory tests, we have focused on detection penetrometer resistance, showing reconsolidation and soil compaction emerging under the wheels of agricultural equipment. Conduct field-laboratory measurements shows the dependence of penetrometer soil resistance on change in tire pressure. Furthermore, the article compares each tire tracks with different tire pressure, double tires and crawler chassis.

Key words: tire, penetrometer resistance, weight, tire pressure

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INTRODUCTION

Influence crossings agricultural mechanization on soil properties is studied for a long time. Currently tested a new design of tires with a flexible skeleton in other clean running gear, such as double tires, three tires (USA) and the rubber tracks. There are different requirements for the use of tires on the road and on the field. They are therefore different requirements for tire manufacturers. At present, there is required higher pressure needed for road, for better manageability and the driving comfort.

They are therefore constructed tires that can handle these requirements tires inflated to the constant pressure. New tires (XeoBib, Axiobib), see Figure 1, provides excellent performance at a constant tire pressure around 90 kPa (0.9 bar). Their construction and specially developed sidewall guarantee good handling on the road and excellent tensile properties when work in the field. The tire was confirm that soil conservation effect is substantially dependent on the internal pressure of the tire. If there is a duplication of the tire (at the same pressure), the contact surface of individual tire increases only by 18%, but if the pressure in the both tires on the third reduced contact area increases to 66% (this corresponds to a very wide tire - more than 800 mm) and reduce slip of up to 30% compared to high pressure in the tire, thereby to better transfer of power tractor on the pad (<http://jos.marme.sweb.cz/pt.htm>).

The reason for using crawler chassis in the 21 century different. Efforts to increase the efficiency of tractor kits led to an increase in engine power and weight of the tractor. Crawler chassis became one of the solutions to efficiently transfer engine power to the pad and reduce the negative effects of higher weight on pad (Bauer, 2006).

MATERIAL AND METHODS

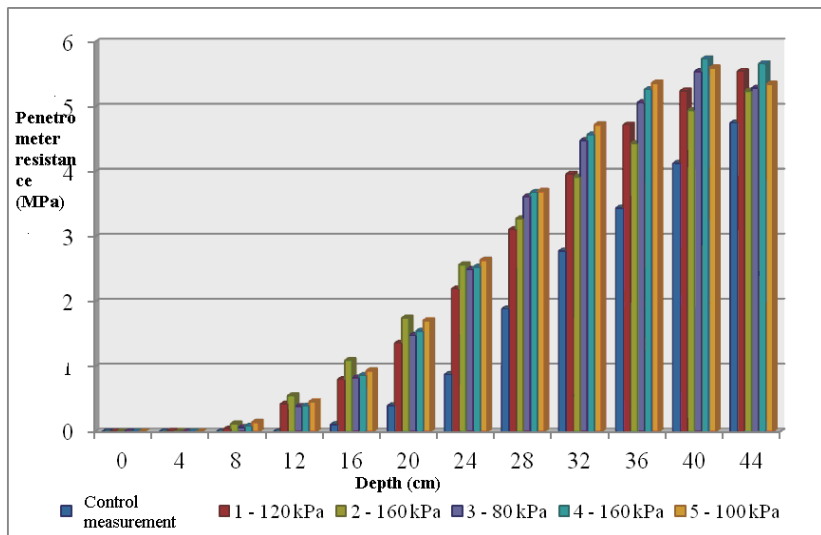
In field of laboratory tests was influence inflation pressure in the tires on penetrometer resistance, which typified the degree of soil compaction. Penetrometer measurements are carried out on the land in the village Jezeřany - Marsovice, There is here type of soil loam sandy, medium light, without skeleton. At the time of measurement (2012) was the site of an extremely dry. Climate region is very warm and dry. Moisture field at the time of measurement was 16.5% in the deaph of 100 mm. On the field was made two shallow stubble cultivation with disc harrow Dowlands DH 6000 to a depth of 70-100 mm and machine Horsch Terrano 5 FX to a depth of 200 mm.

It was marked by five tracks of width of 5 m and a length of 40 m. From the edge of 30 m were measured various variants (tab. 1). Control measurements were marked across the space of ten points. Measurement was carried out successively with two types of tractors, as indicated in the Table 1. First For the same load on both tractors were used fertilizer spreader Rauch ALPHA to 1142. The sets were recorded individual axle loads, the dimensions of tires and a tire pressure monitoring. During measurements were maintained constant speed of 7 km h⁻¹ (Čáp, 2013).

Tab.1 The basic parameters of measured kits

Number of tracks (variant measurement)	1	2	3	4	5
The energy means	Ford New Holland 8770				Z 16145
Aggregation: fertilizer spreader	fertilizer Rauch Alpha 1142				
Total weight [kg]	11300	11300	11550	11550	8200
Weight on the front axle [kg]	3100	3100	3100	3100	1650
Weight on the rear axle [kg]	8200	8200	8500	8500	6550
Front tires	Michelin Multibib 540/65 R30				Mitas 14,9-24 TD-04
Rear tires	Firestone 650/65 R42 Radial 9000 Evolution				Mitas 18,4-34 TD-02
Rear twin tires	-	-	Kleber 20,8 R42 Super 9		-
Pressure in the front tires [kPa]	70	160	70	160	100
Pressure in the rear tires [kPa]	120	160	80	160	100
Pressure in the rear twin tires [kPa]	-	-	80	160	-

RESULT AND DISCUSSION



Graph 1 A comparison of measurements (Čáp, 2013).

In graph 1 is the smallest measured penetrometer resistance of the tractor Ford 8770 without twin tires with pressure of 120 kPa. The highest values of soil resistivity measurements showed diagonal tires on the tractor Zetor 16145. When used tractor Ford 8770 with double tires in dry conditions. Effect on soil penetrometer resistance showed up. It turned out that they had a negative effect, because the soil in the double tires track was equally or more compacted. This measurement showed that in these conditions have not double tires a positive effect on the size and depth of compaction. When using the double tires, the track was greater and greater driving area (Fig. 2 and Fig. 3 imprint tires). Compared with the measurement Ford 8770 without double tires, this area of 1.27 m² larger (imprint tires double tires). Double tires would be good if the tractor is much loaded more heavily, for example, seed combination, sprayer, or by working on the wet field and very softened field.

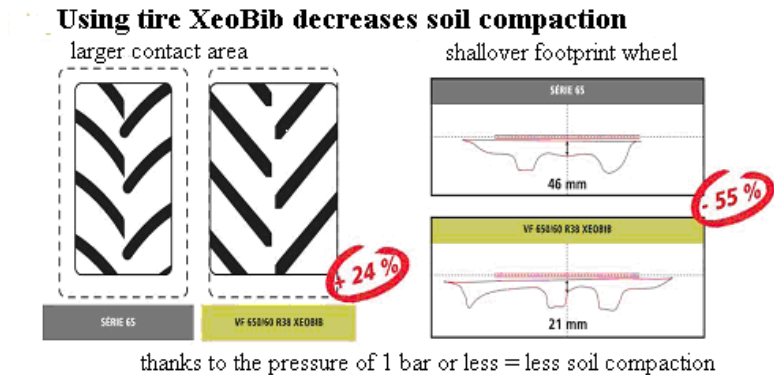


Fig. 1 A comparison conventional tires and Michelin tires XeoBib (www.strompraha.cz)

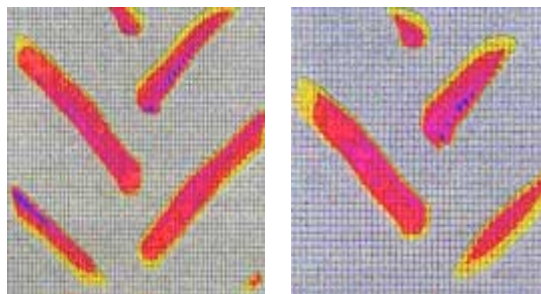


Fig. 2 Tire tracks with a standard tire pressure and under reduced pressure in a tire (<http://jos.marme.sweb.cz/pt.htm>)

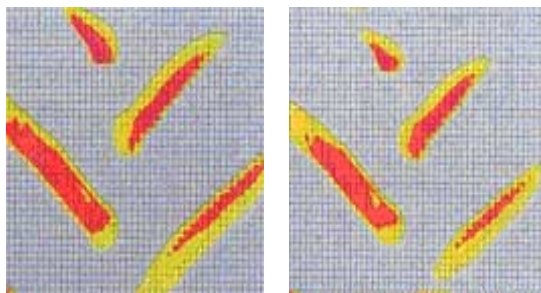


Fig. 3 Tire tracks when using twin tires and waist crawler chassis
(<http://jos.marme.sweb.cz/pt.htm>)

These images show the comparison of individual fingerprints of tires with different inflation pressure and waist. The images show that the tire pressure is lower, the lower the pressure on the soil. The tire pressure is lower, the greater the area of contact with the soil. The double tires and three tires is less pressure on the soil, but larger contact area. Crawler chassis has a low pressure on the soil and a small area of contact. Use of tires with larger dimensions (diameter and tire width) is possible to use a smaller inflation pressure and thus reduce the risk of damage to the soil structure. When using a crawler chassis is appropriate to use an optimal belt width.

CONCLUSIONS

These measurement confirmed that the influence of inflation pressure in a tire influences the penetrometer soil resistance and hence the degree of soil compaction. Excessive compaction of soils is influenced by factors such as weight machines, width and type of tire, softened field and soil moisture. Modern tractors have deliberately higher weight. The machine is better able to transfer engine power to the pad. This compromise manufacturers solved using wide tires to continuously change the tire pressure. In addition to technical solutions must continue to prioritize agro solution, reducing the number of operations, and reducing the depth of the soil to supply sufficient quantities of organic matter. Technical and agro-technical measures reduce the energy intensity of tillage in maintaining soil fertility.

REFERENCES

BAUER, F., SEDLÁK, P., ŠMERDA, T.: Traktory. Knihu vydal Profi Press, 2006, Praha, 192 s. ISBN 80-86726-15-0

ČÁP, M.: Problematika utužení a zhutnění půd technikou v rostlinné výrobě, Diplomová práce, Mendelu v Brně, 2013, 63 stran.

www.strompraha.cz Sortiment agropneumatik a technické parametry, prezentace firmy Michelin

<http://jos.marme.sweb.cz/pt.htm>