The impact of working speed, soil and plough type on tractors’ traction power force at normal tillage

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Abstract
The present paper has as goal to establish the tractors’ traction power force used by two different ploughings units at normal tillage. U-650 tractor and PP-3-30 normal plough and the other one by U-650 tractor and PRP-3 reversible plough form the units. The working conditions are as follows: three different types of soil (light soil, medium soil and heavy soil), four different working speeds (4.48 km/h, 4.61 km/h, 4.88 km/h and 4.98 km/h), working depth is 25 cm and working width is 90 cm. Researches were hosted by Agricultural Research and Development Station Podu-Iloaie, Iași County, Romania. From the presented dates it is obviously that the working unit U-650 + PRP-3 use a higher traction power force of the tractor at all working speeds and all types of soil face to U-650 + PP-3-30 ploughing unit due to the fact that PRP-3 plough is heavier that PP-3-30.

Key words: normal tillage, working speed, soil, plough type, tractors’ traction power force

Introduction
In order to establish the most adequate types of ploughs, which will work in aggregate with the 65 HP tractors, research and experiments have been performed. The main research criteria consist, on one hand, of reaching the imposed agro-technical demands, and on the other hand, of presenting a rational usage of the energetic base. Making the soil basic work, as tillage is known, is in a direct connection with the soil type, which from the point of view of agriculture mechanization has various characteristics, both due to different mechanic features and variations of humidity and soil compaction. The present paper, aims at establishing the optimal type of plough, in order to be able to perform some normal tillage, which will work in aggregate with the 65 HP tractors, within the current framework provided by the conditions of tending and use. The research took into consideration the study of the types of ploughs used for normal tillage (at a depth of 20-25 cm) in aggregate with 65 HP tractors.

Material and methods
To establish the optimal type of plough used for superficial tillage was studied the following two ploughing units:

- aggregate formed by U-650M tractor and PP-3-30 plough;
- aggregate formed by U-650M tractor and PRP-3 reversible plough.

The experiences took place on three types of soil with different specific resistance at ploughing: a light soil with $K_0$ (specific resistance at ploughing) smaller than 0.35 daN/cm$^2$ (typical chernozem) (variant A); a medium soil with $K_0$ (specific resistance at ploughing) between 0.35-0.55 daN/cm$^2$ (chernozem cambic mezocalcaric) (variant B) and a heavy soil with $K_0$ (specific resistance at ploughing) between 0.56-0.75 daN/cm$^2$ (luvosoil) (variant C).
Working speeds, which were used during experiments, were from the II H gear and had the following values: 4.48 km/h; 4.61 km/h; 4.88 km/h and 4.98 km/h. The working depth was 25 cm and working width was 90 cm. Researches were hosted by Agricultural Research and Development Station Podu-Iloaie, Iaşi County, Romania.

**Results and discussions**

In figures 1, 2, 3 and 4 are presented, for those four distinct working speed, the values of tractors’ traction power force when tillage is performed on the three types of soil, with two agricultural units (U-650M+PP-3-30 and U-650M+PRP-3). As a general remark could be mentioned the fact that tractors’ traction power force increase with the increase of specific resistance at ploughing (K₀). In figure 1 are presented the dates for V₁ = 4.48 km/h working speed. When tillage was made on a light soil, using PP-3-30 plough were recorded minimal values (23.14 HP) and for PRP-3 reversible plough were obtained the values of 24.80 HP. Maximum values were recorded at tillage processing on heavy soil, at the usage of PP-3-30 plough obtaining a value of 24.70 HP respectively 26.14 HP at usage of PRP-3 reversible plough.

![Graph 1](image)

**Graph 1. Variation of tractors’ traction power function of soil type (V₁ = 4.48 km/h)**

From the dates presented in figure 2 it is obviously that tractors’ traction power force increase together with the increasing of specific resistance at ploughing also in the case of tillage with 4.61 km/h as working speed. At usage of PP-3-30 plough when tillage was performed on a light soil, were obtained the lowest values (23.47 HP) and for PRP-3 reversible ploughs the values was 25.18 HP. The maximal values were obtained at tillage on heavy soils recording the value of 25.08 HP at PP-3-30 plough usage, and when PRP-3 reversible plough was used the recorded value was 26.55 HP.
Graph 2. Variation of tractors’ traction power function of soil type ($V_2 = 4.61$ km/h)

Dates presented in figure 3 shows once again that the tractors’ traction power force increase at the same time with the increasing of specific resistance at ploughing ($K_0$) also in the case of processing tillage using $V_3 = 4.88$ km/h as working speed. The minimal values were recorded when tillage was made on an easy soil, obtaining 24.40 HP at usage of PP-3-30 plough, respectively 26.22 HP for reversible plough PRP-3. Maximal values were obtained at tillage on heavy soils recording a value of 26.06 HP for using plough PP-3-30 respectively 27.65 HP at using of reversible plough PRP-3.

Graph 3. Variation of tractors’ traction power function of soil type ($V_3 = 4.88$ km/h)
We present in figure 4 the dates regarding working speed $V_4=4.98$ km/h. These dates put in light the fact that tractors’ traction power force increase together with the increasing of $K_0$ (specific resistance at ploughing), so the minimal values of 24.60 HP were recorded when tillage was performed on an easy soil using PP-3-30 plough and 26.46 HP in the case of using PRP-3 reversible plough. As regarding the maximal values, these ones were obtained at tillage on heavy soils, 26.20 HP at using plough PP-3-30, respectively 27.94 HP at using PRP-3 reversible plough.

![Figure 4. Variation of tractors' traction power function of soil type ($V_4 = 4.98$ km/h)](image)

From the previous analyse of the dates result the fact that tractors’ traction power depend by the type of soil where tillage is processed. In this way the minimal values of traction power were recorded at tillage on easy soils and maximal values were obtained in the conditions when tillage was processed on heavy soils. As an impact of the increasing of specific resistance at ploughing, the real working speed decrease fact which affects also the fuel consumption and working capacity of the aggregate. Increasing the specific resistance at ploughing ($K_0$), increase also the tractors’ traction power force, working speed having a very low influence on this power. Traction power force is between very close values for tillage processing on the same type of soil, with the same working aggregate and with different working speeds. At tillage processing with plough PP-3-30, with the four working speeds ($V_1=4.48$ km/h; $V_2=4.61$ km/h; $V_3=4.88$km/h and $V_4=4.98$ km/h), traction power force had for easy soils values between 23.14 HP and 24.60 HP; for medium soils the values were between 23.56 HP and 25.28 HP while at tillage on heavy soils the values were 24.70-26.20 HP. At processing normal tillage with PRP-3 reversible plough, with the same four working speeds, tractors’ traction power force had for easy soil values between 24.80-26.46 HP; for medium soil values from 25.13 HP to 26.98 HP; and for heavy soil the values were in the interval 26.14-27.94 HP.
Conclusions
The more the soil resistance to ploughing increases, the greater the tractors’ traction power force gets. As long as the tillage work, in its normal dimension, is carried out with the PRP-3 reversible plough, its tractors’ traction power force is about to record higher values than those recorded by the PP-3-30 plough, regardless the soil type and working speed. What accounts for this state of affairs is the fact that the weight of the PRP-3 reversible plough exceeds the one of the PP-3-30 plough by 73% (weight of PRP-3 reversible plough is 625 kg face to 360 kg the weight of PP-3-30 plough).

References
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