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# Research regarding the specific fuel consumption at superficial tillage function of working speed, soil and plough type

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## Abstract

The aim of the paper is to present which is the influence induced by working speed, plough and soil type, on specific fuel consumption at superficial tillage. To achieve the goal were used two types of mouldboard ploughs, one of them is a conventional plough with three furrows (*PP-3-30*) and the second one is a reversible plough with three furrows on each side (*PRP-3*). The tractor used was a 65 HP one. The research took place on three different types of soil and we worked with four different speeds. The results showed that using the reversible plough leads to better values comparing with the usage of the conventional one.

Keywords: superficial tillage, soil, working speed, plough type, fuel consumption

## Introduction

In order to establish the most adequate types of ploughs, which will work in aggregate with 65 HP tractors, research and experiments have been performed. Ploughs, which are very used units, and that have been thoroughly studied and known at an international as well as national level, have reached a high technical stage, and the essential changes of the nowadays functional and constructive principles are very hard to carry out. 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. So, each element that can provide even a small improvement in the quality of tillage, an increase in labour productivity, a decrease in the direct expenditures per hectare or in fuel and metal consumption, have an important role upon the increase of economic efficiency. 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 soil moisture and soil compaction.

## Material and method

To establish the optimal types of plough used for superficial tillage were studied the following two ploughing units:

a *PP-3-30* conventional plough (figure 1);
a *PRP-3* reversible plough (figure 2).

**Figure 1. *PP-3-30* plough**

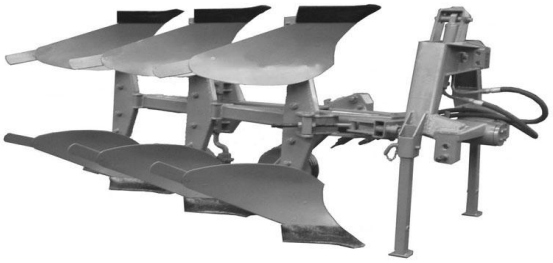


**Figure 2. *PRP-3* reversible plough**

In table 1 are presented the main technical characteristics of ploughs.

**Table 1. The main technical characteristics of ploughs**

| Main characteristics | *PP-3-30* plough | *PRP-3* reversible plough |
|---|---|---|
| Number of furrows | 3 | 3+3 |
| Working width per furrow (cm) | 30 | 30 |
| Ploughs' working width (cm) | 90 | 90 |
| Ploughs' working depth (cm) | 30 | 30 |
| Weight of plough (kg) | 360 | 625 |

The experiences were hosted, during 2006-2008, by the experimental plots of Agricultural Research-Development Station (S.C.D.A) Podu-Iloaie, Iaşi County, Romania, on three soil types with different specific resistance at tillage: a light soil (typical chernozem – variant 1); a medium soil (chernozem cambic mezocalcaric – variant 2) and a heavy soil (luvisol with moderate compaction – variant 3) on a winter wheat stubble-field (table 2). Working speeds, which were used during experiments, were from the II H gear and had the following values: $v_1$=4.48 km h$^{-1}$; $v_2$=4.61 km h$^{-1}$; $v_3$=4.85 km h$^{-1}$ and $v_4$=4.98 km h$^{-1}$. The working depth was $a$ = 20 cm and working width was $B_w$ = 90 cm.

**Table 2. Soil type variants**

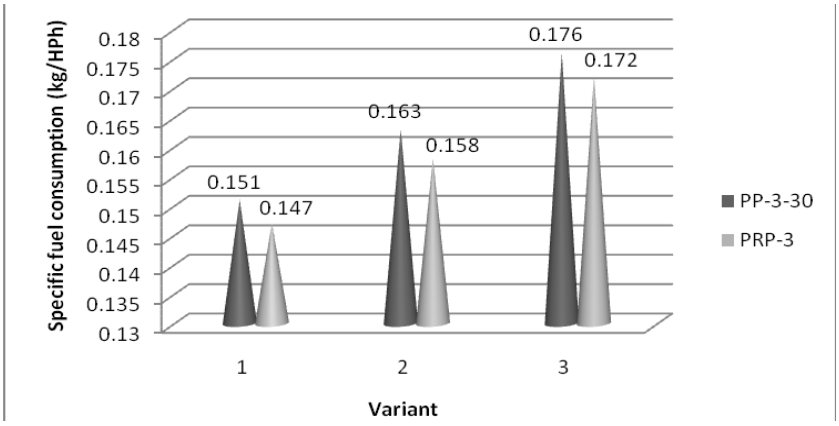
| Working conditions | Variant | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| Soil type | Typical chernozem | Chernozem cambic mezocalcaric | Luvisol with moderate compaction |
| Soil texture | Loamy sand | Clay loam | Clay |
| Vegetal mass | Wheat stubble-field | Wheat stubble-field | Wheat stubble-field |
| Density of stubble-field (plants/m$^2$) | ≈450 | ≈450 | ≈450 |
| Height of stubble-field (cm) | 15 | 15 | 15 |
| Specific resistance ($K_0$) at ploughing (daN/cm$^2$) | <0.35 (light soil) | 0.35-0.55 (medium soil) | 0.56-0.75 (heavy soil) |

## Results and discussions

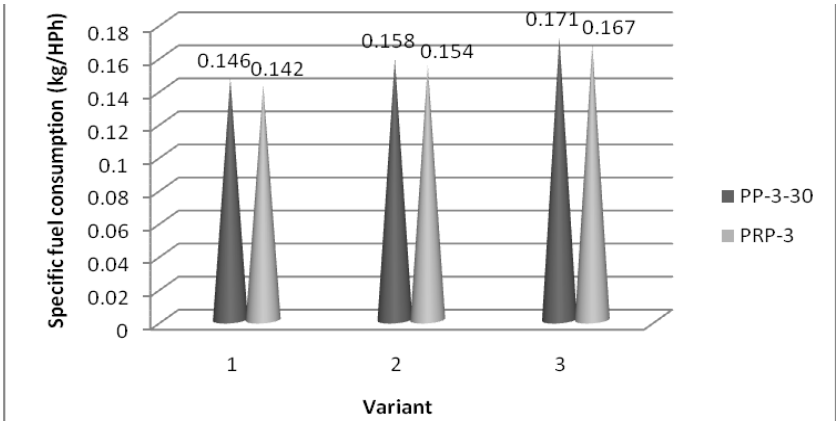
As it is shown in graph 1 specific fuel consumption record, for working speed $v_1$=4.48 km h$^{-1}$, values which increase function of soil type, for both ploughing units. So the lowest values of specific fuel consumption were recorded on a light soil having minimums of 0.151 kg/HPh (*U-650M+PP-3-30*), respectively 0.147 kg/HPh (*U-650M+PRP-3*), and maximum values were recorded at processing tillage on a heavy soil (0.176 kg/HPh respectively 0.172 kg/HPh).

For $v_2$=4.61 km h$^{-1}$, (graph 2), specific fuel consumption record values which increase function of soil type for both working units. The values which are lower are obtained on a light soil having minimums of 0.146 kg/HPh (*U-650M+PP-3-30*) respectively 0.142 kg/HPh (*U-650M+PRP-3*) and maximum ones were obtained at processing tillage on a heavy soil (0.171 kg/HPh respectively 0.167 kg/HPh).

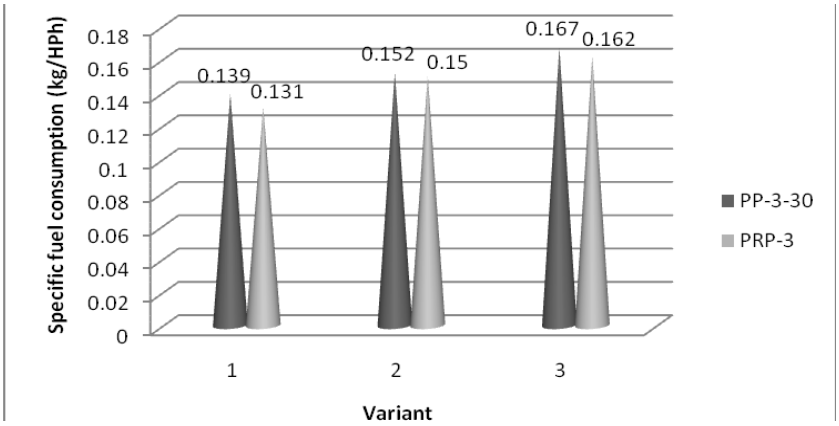
The specific fuel consumption recorded, for $v_3$=4.85 km h$^{-1}$ working speed, values which increase function of soil type, for both working aggregates (graph 3). In this way the lowest values of specific fuel consumption were obtained on a light soil having minimums of 0.139 kg/HPh (*U-650M+PP-3-30*) respectively 0.131 kg/HPh (*U-650M+PRP-3*) and the maximum values were recorded at tillage processing on a heavy soil (0.167 kg/HPh respectively 0.162 kg/HPh).




**Graph 1. Variation of fuel specific consumption function of soil type ($v_1$ = 4.48 km $h^{-1}$)**

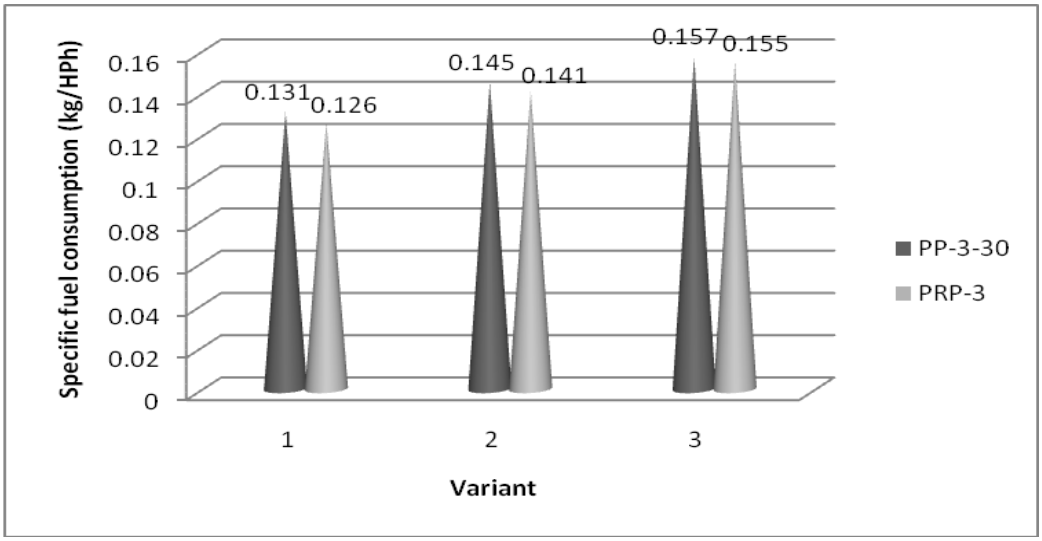



**Graph 2. Variation of fuel specific consumption function of soil type ($v_2$ = 4.61 km $h^{-1}$)**




**Graph 3. Variation of fuel specific consumption function of soil type ($v_3$ = 4.85 km $h^{-1}$)**

In graph 4 are presented the dates regarding specific fuel consumption which are recorded for working speed $v_4$=4.98 km $h^{-1}$, values which increase function of soil type again for both ploughings units. The lowest values of specific fuel consumption are recorded for light soil having minimums of 0.131 kg/HPh (U-650M+PP-3-30) respectively 0.126 kg/HPh (U-650M+PRP-3), and the maximum values were recorded at processing tillage on a heavy soil (0.157 kg/HPh respectively 0.155 kg/HPh).




**Graph 4. Variation of fuel specific consumption function of soil type ($v_4$ = 4.98 km h$^{-1}$)**

## Conclusions

Based on the above presented data result that the minimum values of specific fuel consumption were recorded at processing superficial tillage on light soils using *PRP-3* reversible plough and the maximum values of specific fuel consumption were obtained at tillage processing on heavy soils using conventional plough *PP-3-30*.

On the same type of soil and using the same working speed specific fuel consumption did not record great differences at using one or another ploughing units (*U-650M+PP-3-30* or *U-650M+PRP-3*), but the specific fuel consumption at processing tillage with *PRP-3* reversible plough was lower, due to the fact that turns at the end of the plots were reduced for *PRP-3* plough because its shifting mechanism.

## References

Avarvarei B.V (2007). Research regarding the establishment of plough type for superficial and normal tillage. PhD. Thesis. University of Agricultural Sciences and Veterinary Medicine from Iaşi. ROMANIA.