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Soil structure after treatment with different operation modes of spading machine

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Abstract. The article presents the results of a field survey of the work of a spading machine. The influence of the following factors on the structure of the Chernozem type soil has been investigated: operating speed, deflector cover deflection angle and rotation speed of the power take-off shaft of the tractor on soil crushing. The relative share of aggregates smaller than 1mm, from 1 to 10mm, from 10 to 25mm, from 25 to 50mm, from 50 to 100mm and over 100mm has been determined. Regression relations have been created to determine the proportion of soil fractions of certain sizes depending on the controllable factors.

The operating speed and the position of the machine cover have the greatest influence on the granulometric composition of the soil in cultivation with a spading machine. The resulting regression relations can be used to determine the operating parameters of the machine to achieve the desired granulometric composition of the soil depending on the purpose of the cultivation.

Keywords: spading machine, granulometric composition of soil, operating speed, PTO speed, step of the working tools

Introduction

Ordinary ploughs are traditionally used for basic soil cultivation. Their plough bodies cut the soil layer, then lift it, move it away and turn it. They have the following main disadvantages: formation of the so-called “plow pan”, poor mixing of plant residues, distortion of the field microrelief as the soil is moved away in laterally in the direction of movement. The latter is a serious problem in basic soil cultivation in greenhouses or undersized plots. Unlike ploughs, when using spading machines there is no compaction of the sub-plough layer (Brzózko and Murawski, 2007). These machines work on the principle of reversing the soil with a straight shovel. The working tools of the machines (spades) cut off the soil almost vertically, break it off and move it backwards (Giordano et al., 2015). With this principle of soil reversal, uniform distribution of plant residues is achieved throughout the entire cultivation depth (Juzwik et al., 1997).

The basic soil cultivation with the spading machine contributes to a positive agronomic effect on the penetration and location of the plant roots in the soil (Gasparetto, 1966). Spading machines are suitable for soil cultivation in small-sized plots, greenhouses, vegetable gardens, etc., where the application of ploughs is problematic (Kiselev, 1995). In addition to the basic cultivation, soil structure suitable for sowing without other soil cultivation operations can be achieved (Giordano et al., 2015). This is achieved by changing the step of the working tools by varying the speed of the machine (Donati and Fedrizzi, 2018). From an agronomic point of view the most precious fraction in pre-sowing soil cultivation are aggregates with diameter between 0.5–10mm (Mandradzhiev, 1982).

Material and methods

The study has been conducted at the farm of agricultural producer „Agro New Bulgaria “Ltd., situated on the territory of the village of Gornik, Cherven bryag municipality in June 2017. The soil type of the experimental field was Chernozem with moisture about 10%. Spading machine Gramegna V 84/30B–220 has been used (Figure 1), attached to tractor Landini Vision 100. The technical parameters of the machine are given in Table 1.

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Multi-factor experiment type B has been carried out with the following values of the controlled factors:

- $x_1$ – operating speed: $v = 0.063 \text{ m/s}$; $v = 0.147 \text{ m/s}$ and $v = 0.231 \text{ m/s}$. This is achieved through changing the tractor gears;
- $x_2$ – deflection angle of the deflector cover as to the vertical plain: $\alpha = 0^\circ$; $\alpha = 20^\circ$ and $\alpha = 40^\circ$. The position of the cover is determined by the relevant chain-unit, attached to the machine frame;
- $x_3$ – frequency of rotation of the tractor PTO: $n = 460 \text{ min}^{-1}$; $n = 500 \text{ min}^{-1}$ and $n = 540 \text{ min}^{-1}$.

The baseline output parameters are the relative share $Y$ of the soil aggregates of a certain size. The soil aggregates dimensions are determined according to the Kachinsky classification (Kachinsky, 1965). During each experiment from the experiment plan a soil sample is taken to working depth, which is divided by sieves into fractions of different aggregate sizes. Sieves with openings 1, 10, 25, 50 and 100 mm are used, these are weighed to the nearest 1g and the values are averaged. The relative share of fractions in the sample is determined by the dependence (Tenu et al., 2012):

$$ Y_n = \frac{G_{cf}}{G_e} \times 100, \% $$

Where:

- $G_{cf}$ is the weight of a certain fraction, g;
- $G_e$ - the weight of the entire sample, g.

Depending on the size of the aggregates, the output parameters are:

- $Y_{(<1)}$ – relative share of aggregates sized under 1 mm, %;
- $Y_{(1-10)}$ – relative share of aggregates sized from 1 to 10 mm, %;
- $Y_{(10-25)}$ – relative share of aggregates sized from 10 to 25 mm, %;
- $Y_{(25-50)}$ – relative share of aggregates sized from 25 to 50 mm, %;
- $Y_{(50-100)}$ – relative share of aggregates sized from 50 to 100 mm, %;
- $Y_{(>100)}$ – relative share of aggregates sized over 100 mm, %.

Data processing has been done by standard methods (Mîlîcov, 2011) with the software package STATISTICA. Regression dependences have been defined for each baseline output parameter of the following type:

$$ Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_{12}x_1x_2 + b_{13}x_1x_3 + b_{23}x_2x_3 + b_{11}x_1^2 + b_{22}x_2^2 + b_{33}x_3^2 $$

To illustrate the effect of the main factors diagrams of the lines at one and the same level are used.

### Table 1. Technical parameters of spading machine Gramegna V84/30B-220

<table>
<thead>
<tr>
<th>Technical parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working width, m</td>
<td>2.15</td>
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<td>Overall width, m</td>
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</tr>
<tr>
<td>Weight, kg</td>
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<tr>
<td>Required power, kW</td>
<td>44 – 51</td>
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<tr>
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<tr>
<td>Number of blades spades</td>
<td>10</td>
</tr>
<tr>
<td>Gear ratio of the reducer, $i$</td>
<td>3.21</td>
</tr>
<tr>
<td>PTO speed, min$^{-1}$</td>
<td>540</td>
</tr>
</tbody>
</table>

### Results and discussion

#### Experimental matrix

The experimental matrix and the results obtained from the conducted studies are presented in Table 2.

The following regression dependencies have been obtained in studying the soil structure after cultivation with a spading machine and processing the results obtained:

**Fraction sized less than 1 mm**

$$ Y_{(<1)} = -3.02293 + 0.01935x_3 - 0.02525x_1x_3 + 7.82182x_1^2 - 0.00054x_3^2 $$

Significant at $\alpha=0.1$ are the free coefficient and the coefficients before $x_1^2$, $x_2^2$ and $x_3$. The model describes 97% ($R^2=0.9752$) of the change of parameter $Y_{(<1)}$. The probability $p<0.00001<0.1$ shows that it is adequate. Fischer’s criterion is $F_{(4,9)} = 88.417$.

The diagram on Figure 2 shows that the minimum share of the fraction sized less than 1mm is obtained at high operating speed and small rotation frequency of the PTO. When reducing the speed of movement ($x_1$) the share of the fraction increases. The change in the rotation frequency of the PTO ($x_3$) within the accepted limits does not exert significant influence on the share of that fraction. It grows negligibly by increasing the rotation speed.

In greater rotation speed of the machine crankshaft, the speed of the spade will be greater as well as the speed of the soil aggregate throw away by the workpiece spade. The kinetic energy of the aggregate hitting the cover will grow, which facilitates the better crushing and increasing the share of aggregates with these sizes. These aggregates are considered erosion hazardous.

**Fraction sized from 1 to 10 mm**

$$ Y_{(1-10)} = 63.95207 - 0.14x_3 $$

Significant at $\alpha=0.1$ are the free coefficient and the coefficient before the joint influence of $x_1x_3$. Effect of the $x_1$ factor is not reported at $\alpha=0.1$. The model describes 80% ($R^2=0.8008$) of the change of parameter $Y_{(1-10)}$. The probability $p=0.00002<0.1$ shows that it is adequate. Fischer’s criterion is $F_{(1,12)} = 48.184$. 

![Figure 2. Surface of response of the function $Y_{(1-10)}(x_1; x_3)$ at $x_3 = 40^\circ$](image-url)

<table>
<thead>
<tr>
<th>Fraction sized from 1 to 10 mm</th>
</tr>
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![Table 1. Technical parameters of spading machine](image-url)

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Aggregates with sizes up to 10mm are the most desired in pre-sowing soil tillage. When using the machine for pre-sowing soil tillage it is preferable the share of that fraction to be maximum. Figure 3 shows that by decreasing the rotation frequency of the PTO ($x_3$) and the operating speed ($x_1$) the share of aggregates with this size increases. Basic influence on obtaining that fraction is exerted by the machine operating speed ($x_1$). By decreasing the operating speed mainly by switching gears the step of the spades is reduced, the removed layer is small in size and mass, which facilitates easier crushing after hitting the machine cover. The reduction in the rotation frequency results in slight increase of the share of aggregates with that size. The rotation frequency of the PTO influences mainly the speed of throwing away the soil layer by the spade. In greater rotation speed the absolute speed of releasing the soil layer by the spade will increase, and hence the kinetic energy at the moment of hitting the cover. That facilitates crushing the layer into aggregates of smaller size.

**Fraction sized from 10 to 25 mm**

$$Y_{(10-25)} = 794.4312 + 0.5684x_2 - 3.1143x_3 - 39.8582x_2^2 - 0.0151x_3^2 + 0.0031x_3^3$$

(5)

It is evident that significant at $\alpha = 0.1$ are the free coefficient and the coefficients before $x_2^2$, $x_3^2$ and $x_3^3$. The model describes 94% ($R = 0.94152$) of the change of parameter $Y_{(10-25)}$. The probability is $p<0.0001<0.1$, which shows that it is adequate. Fischer’s criterion is $F_{(5,8)} = 25.76$.

Aggregates of that size, as well as the previous ones (sized from 1 to 10mm) should have greater share when using the machine for pre-sowing tillage. In low and high values of the rotation speed of the PTO ($x_3$) the share of that fraction is the greatest (Figure 4), which is due to the increase in the absolute speed of releasing the layer by the spade and the smallest in the middle of the studied interval. As in the previous case, by decreasing the operating speed of the machine, the share of aggregates with this size increases.

**Fraction sized from 25 to 50 mm**

**Fraction sized over 50 mm**

<table>
<thead>
<tr>
<th>Experiment No.</th>
<th>Factors encoded</th>
<th>Share of the fraction in percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$x_1$ $x_2$ $x_3$</td>
<td>Under 1 mm</td>
</tr>
<tr>
<td>1</td>
<td>+1 +1 -1</td>
<td>0.7</td>
</tr>
<tr>
<td>2</td>
<td>+1 -1 -1</td>
<td>1.46</td>
</tr>
<tr>
<td>3</td>
<td>+1 0 0</td>
<td>1.34</td>
</tr>
<tr>
<td>4</td>
<td>+1 -1 +1</td>
<td>1.82</td>
</tr>
<tr>
<td>5</td>
<td>+1 +1 +1</td>
<td>0.68</td>
</tr>
<tr>
<td>6</td>
<td>0 0 -1</td>
<td>1.74</td>
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<tr>
<td>7</td>
<td>0 -1 0</td>
<td>2.18</td>
</tr>
<tr>
<td>8</td>
<td>0 +1 0</td>
<td>0.99</td>
</tr>
<tr>
<td>9</td>
<td>0 0 +1</td>
<td>2.13</td>
</tr>
<tr>
<td>10</td>
<td>-1 +1 -1</td>
<td>3.16</td>
</tr>
<tr>
<td>11</td>
<td>-1 -1 -1</td>
<td>3.49</td>
</tr>
<tr>
<td>12</td>
<td>-1 0 0</td>
<td>4.3</td>
</tr>
<tr>
<td>13</td>
<td>-1 -1 +1</td>
<td>4.52</td>
</tr>
<tr>
<td>14</td>
<td>-1 +1 +1</td>
<td>3.8</td>
</tr>
</tbody>
</table>
Fraction sized from 25 to 50 mm

\[ Y_{(25-50)} = 26.66315 - 0.05875x_1x_3 \]  \hspace{1cm} (6)

It is evident from the function that significant at \( \alpha = 0.1 \) are the free coefficient and the coefficient before the joint effect of the factors \( x_1x_3 \). The effect of the factor \( x_1 \) at \( \alpha = 0.1 \) is not taken into account. The model describes 57\% (\( R^2 = 0.5727 \)) of the change of parameter \( Y_{25-50} \). The probability \( p < 0.00173 < 0.1 \) shows that it is adequate. Fischer’s criterion is \( F_{(1,12)} = 16.084 \).

Basic influence on obtaining aggregates of that size has the operating speed \( x_1 \), and by decreasing it the share of the fraction increases (Figure 5). That is due to throwing away aggregates of greater size and their poorer crushing. Rotation frequency has small effect on obtaining aggregates of such size.

Fraction sized from 50 to 100 mm

\[ Y_{(50-100)} = -7561.64 + 24.82x_1 + 30.43x_3 - 0.03x_3^2 \]  \hspace{1cm} (7)

The function shows that significant at \( \alpha = 0.1 \) are the free coefficient and the coefficients before \( x_1 \) and \( x_3 \). The effect of factor \( x_3 \) at \( \alpha = 0.1 \) is not reported. The model describes 59\% (\( R^2 = 0.59907 \)) of the change of parameter \( Y_{50-100} \). The probability \( p < 0.02286 < 0.1 \) shows that it is adequate. Fischer’s criterion is \( F_{(1,10)} = 4.9808 \).

Similar size of aggregates is suitable for basic soil cultivation. The minimum share of that fraction (Figure 6) is obtained in low rotation frequency of the PTO (\( x_3 \)) – 460 min\(^{-1}\). At frequency above 460 min\(^{-1}\) kinetic energy increases, which facilitates obtaining fraction of smaller size (less than 50mm). By increasing the operating speed (\( x_1 \)) the share of that fraction increases mainly due to increase of the step of the spades.

Fraction sized above 100 mm

\[ Y_{(>100)} = -36.8548 + 0.2402x_1x_3 \]  \hspace{1cm} (8)

It is evident that significant at \( \alpha = 0.1 \) are the free coefficient and the coefficient before the joint effect of \( x_1x_3 \). The effect of the factor \( x_1 \) at \( \alpha = 0.1 \) is not reported. The model describes 54\% (\( R^2 = 0.5427 \)) of the change of parameter \( Y_{>100} \). The probability \( p < 0.00264 < 0.1 \) shows that it is adequate. Fischer’s criterion is \( F_{(1,12)} = 14.257 \).

Aggregates of that size as well as the previous ones are suitable for basic soil cultivation. The minimum share of the fraction (Figure 7) is achieved at low operating speed (\( x_1 \)). The rotation frequency of the PTO slightly alters the share of that fraction with these sizes.

Figure 5. Surface of response of the function \( Y_{(25-50)} = f(x_1; x_3) \)

Fraction sized from 50 to 100 mm

\[ Y_{(50-100)} = -7561.64 + 24.82x_1 + 30.43x_3 - 0.03x_3^2 \]  \hspace{1cm} (7)

The function shows that significant at \( \alpha = 0.1 \) are the free coefficient and the coefficients before \( x_1 \) and \( x_3 \). The effect of factor \( x_3 \) at \( \alpha = 0.1 \) is not reported. The model describes 59\% (\( R^2 = 0.59907 \)) of the change of parameter \( Y_{50-100} \). The probability \( p < 0.02286 < 0.1 \) shows that it is adequate. Fischer’s criterion is \( F_{(1,10)} = 4.9808 \).

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Figure 6. Surface of response of the function \( Y_{(50-100)} = f(x_1; x_3) \)

Figure 7. Surface of response of the function \( Y_{(>100)} = f(x_1; x_3) \)

Research has shown the achievement of a broad range of changes in the share of aggregates sized over 100mm. By changing the machine modes, soil with a different granulometric composition can be obtained. A major impact on soil crushing is the step of the spades (by changing the gears and hence the operating speed) and the position of the machine cover. In small step obtained at low operating speed, as well as at a small angle of deflection of the cover from the vertical plane, soil is crushed to a condition suitable for sowing, planting or transplanting. At a larger step obtained by increasing the operating speed and at greater angle of deflection of the cover, soil is crushed to a condition corresponding to basic tillage.

Conclusion

The regression dependences for determining the share of soil fractions of certain size have been drawn in relation to operating speed, frequency of rotation of the PTO of the tractor and the position of the deflector cover. The granulometric composition of the soil when cultivated with a spading machine is influenced by the machine operating speed and the position of the cover. The resulting regression dependences can be used to determine the operating parameters of the machine to achieve the desired granulometric composition of the soil depending on the cultivation purposes.
References


Mandradzhiev S, 1982. Study on the change of the traction force and optimizing the mode of work of soil cultivating milling machines. Thesis for PhD, Agricultural University, Plovdiv (Bg).


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The title needs to be as concise and informative about the nature of research. It should be written with small letter /bold, 14/ without any abbreviations.

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The introduction must answer the following questions: What is known and what is new on the studied issue? What necessitated the research problem, described in the paper? What is your hypothesis and goal?

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Results are presented in understandable tables and figures, accompanied by the statistical parameters needed for the evaluation. Data from tables and figures should not be repeated in the text. Tables should be as simple and as few as possible. Each table should have its own explanatory title and to be typed on a separate page. They should be outside the main body of the text and an indication should be given where it should be inserted.

Figures should be sharp with good contrast and rendition. Graphic materials should be preferred. Photographs to be appropriate for printing. Illustrations are supplied in colour as an exception after special agreement with the editorial board and possible payment of extra costs. The figures are to be each in a single file and their location should be given within the text.

Discussion: The objective of this section is to indicate the scientific significance of the study. By comparing the results and conclusions of other scientists the contribution of the study for expanding or modifying existing knowledge is pointed out clearly and convincingly to the reader.

Conclusion: The most important consequences for the science and practice resulting from the conducted research should be summarized in a few sentences. The conclusions shouldn't be numbered and no new paragraphs be used. Contributions are the core of conclusions.

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