

COMPARATIVE ANALYSIS OF SOIL CRUSHING AFTER PLOUGHING WITH TWO TYPES OF PLOUGHBODIES

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Abstract: The paper presents a comparative analysis of soil crushing after ploughing with ploughbodies with a classical plowing surface and those with lamellar surface.

Keywords: soil crushing, ploughing.

1. Introduction

In world information is not correct information about different of crushing of soil after ploughing with different ploughbodies.

The general purpose of the study is comparative analysis of soil crushing after ploughing with ploughbodies with a classical plowing surface and those with lamellar surface at different soil humidities on two soil backgrounds.

2. Materials and methods

The study is carried out by a single-passive experiment, with the ground parameter being the crushing of the soil, while the absolute humidity of the soil is the controlling factor. As a concomitant factor, soil hardness is taken into account.

One-factor dispersion analysis determines whether there is a proven difference in granulometric composition of the soil after treatment at each experiment at different humidity.

The crushing of the ploughing soil is measured by the fractional of the particle size fraction (granulometric composition).

The particle size grading is determined in parallel for both types of plough bodies, taking samples from the entire depth of the treated layer.

Relative fraction of particles below 1 mm, from 1 to 25 mm (desired fraction), from 25 to 100 mm and above 100 mm are reported.

The relative share of soil fractions is determined for each experiment. Equal distances along the test bed are taken on three soil samples, which are placed in buckets with a volume of more than 12 liters. According to the length of the test bed soil samples are taken at equal distances. Take the samples taken in a dry, closed place, where they are naturally dried and then split into fractions through holes 1 and 25, weigh to the nearest 1, and determine the relative proportion of the individual fractions.

Prior to sowing the soil samples, the lumps of size over 100 are visually separated, with a size greater than 100 determined by a roller blind, with the lumps of this size being counted as a separate fraction. This is because clumps of these sizes in sifting after drying are demolished to smaller ones, so they can not be counted in this fraction.

The relative share of the fractions in the sample is determined by the dependence (1):

$$(1) \quad P = \frac{G_{\phi p}}{G_p} \cdot 100, \%$$

where: $G_{\phi p}$ is the mass of a fraction, kg;
 G_p is the mass of the whole sample, kg.

To confirm the relative fraction of the fractions, repeat the experiments of another experimental bed with the same soil conditions.

$$(2) \quad W_a = \frac{G_B - G_C}{G_C} \cdot 100, \%$$

where: G_w is the mass of moist soil, kg;
 G_C - mass of dry soil, kg.

Humidity is determined for each soil sample taken and is determined by the dependence (2).

As a concomitant factor, soil hardness is measured before treatment. The hardness of the soil is determined by a hardener described by Kolev 1982. At each experimental plot, the hardener is shaken to the depth of processing and the instrument scale reading reads. Soil hardness is calculated using the formula (3) (Kolev, 1982):

$$(3) \quad F = \frac{k \cdot a}{S}$$

where: T is the soil hardness in Pa,
 k - the elastic constant of the spring in N/m,
 a - deformation of the spring in m,
 S - the area of the deformer in m².

3. Results of the study and Discussion.

General conditions for conducting the survey.

The surveys were carried out in 2018 on the land of the town of Chirpan on a soil background with a clay mechanical composition (82 – 89% clay) and in the village of Malak chardak, Plovdiv area on a soil background with sandy mechanical composition.(87 – 92% sand) In both cases, the studies were conducted on ploughing of wheat stalk.

The surveys were conducted with two tri plough bodies reversible plough, one equipped with classical plough bodies and the other with lamellar. On both plows, the working width of one plough body is 0.4 m and the shape of the pivot surface is semi-continuous. Both ploughs are aggregated with a JD-7610 tractor, with an engine power of 107 kW and a mass of 6510 kg. The tests are carried out on gear P11 and 80% throttle, which achieves a working speed of about 7 km/h.

The ploughs are adjusted to a working depth of 0.3 m.

The length of the workflow for both investigated sections is about 300 ÷ 350 m.

Table 1: Results of research of soil with sand mechanical composition in conditions:

$$W\% = 21,1 \div 22,1$$

$$T = 1,28 \div 11,36 \text{ MPa}$$

Fractions mm	A1			A2		
<1	1,4	3,5	4,2	2,2	3,2	4,3
1÷25	27,6	29,7	38,5	23,7	42,2	40,3
25÷100	64,6	66,8	51,5	68,3	52,1	50,7
>100	5,4	-	6,8	5,85	2,5	4,7

Table 2: Results of research of soil with sand mechanical composition in conditions:

$$W\% = 15,8 \div 16,7$$

$$T = 1,38 \div 1,49 \text{ MPa}$$

Fractions mm	A1			A2		
<1	6,7	8,6	10,8	7,2	8,4	9,8
1÷25	65,8	54,6	62,4	55,4	57,6	68,3
25÷100	27,5	36,8	26,8	37,4	34	21,9
>100	-	-	-	-	-	-

Table 3: Results of research of soil with sand mechanical composition in conditions:

$$W\% = 11,6 \div 13,1$$

$$T = 1,51 \div 1,62 \text{ MPa}$$

Fractions mm	A1			A2		
<1	10,6	14,8	16,8	8,4	15,6	17,1
1÷25	41,9	33,1	31,9	48,2	34,9	30,5
25÷100	40,1	48,3	48,7	39,2	44,1	47,6
>100	7,4	3,8	2,6	4,2	5,4	4,8

Table 4: Results of research of soil with clay mechanical composition in conditions:

$$W\% = 20,4 \div 21,8$$

$$T = 1,63 \div 1,72$$

Fractions mm	A1			A2		
<1	-	-	-	-	-	-
1÷25	2,2	5,8	7,2	4,7	5,2	7,6
25÷100	36,8	35,6	44,6	38,9	52,8	51,3
>100	61	58,6	48,2	56,4	42	41,1

Table 5: Results of research of soil with clay mechanical composition in conditions:

$$W\% = 15,5 \div 16,8$$

$$T = 1,78 \div 1,84 \text{ MPa}$$

Fractions mm	A1			A2		
<1	-	1,2	4,1	1	3,5	2
1÷25	39,4	43,1	51,6	39	42,6	54,2
25÷100	36,2	42,1	44,3	33,5	43,1	43,8
>100	24,4	13,6	-	26,5	10,8	-

In all tables present above A1 is variant of ploughbody whit classical surfase and A2 whit lamellar surface.

After statistical treatment the results in tables 1 – 5 between variants A1 and A2 statistical proved differences with 95% probability are in Table 1 and Table 4.

Therefore soil crushing after ploughing with ploughbodies with a classical plowing surface and those with lamellar surface are statistical proved by conditions of high soil humidity.

4. References

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