THE VARIATION OF THE RATIO LEVEL OF THE SOIL AFTER ITS PROCESSING IN A CLASSICAL TILLAGE SYSTEM AND IN A MINIMUM TILLAGE SYSTEM

VARIAȚIA GRADULUI DE MĂRUNȚIRE A SOLULUI ÎN URMA PRELUCRĂRII ÎN SISTEM CLASIC ŞI SISTEM MINIM

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Abstract: *This paper presents the results obtained regarding the influence of the processing method of the soil on the ratio level. In order to determine the ration level, after each technical work, an expedite, though precise method was conceived which can be used to analyse the influence of the preparing system of the soil on this physical-mechanical propriety.*

Rezumat: *În lucrarea de față sunt prezentate rezultatele obținute în urma prelucrării solului în sistem clasic şi în sistem minim asupra gradului de mărunțire. Pentru determinarea gradului de mărunțire, după fiecare lucrare tehnică, s-a conceput o metodă expeditivă dar precisă, cu ajutorul căreia se poate analiza influența sistemului de pregătire a solului asupra acestei proprietăți fizico mecanice.*

Key words: *ratio level, clumps, minimum tillage system*
Cuvinte cheie: *grad de mărunțire, bulgări, sistem minim*

INTRODUCTION

In modern perspective, the soil structure represents one of the essential characteristics with direct impact on all physical, mechanical and biological processes which take place in the soil.

According to the dimension, form, way of constitution and cohesion, the aggregates may present proprieties more or less favourable for the circulation of the water and air and for the immersion of the roots (ȚOPA D., G. JITĂREANU, 2007).

Conventional agriculture uses intensive techniques which imply high energetic inputs and contribute to the soil degradation manifested through the loss of organic substances, erosion and compaction. To a great extent, all these lead to negative effects on the quality of the soil, water and air (RUSU T., GUŞ P., 2007).

The technology of ecological mechanisation of the main processing of the soil in a minimum system accomplishes its processing without upsetting the furrow and ensures the limitation of the operations for soil processing, ameliorates the structure and raises the maintaining capacity of humidity (POPESCU I.,1984).

This paper presents the results obtained regarding the influence of the processing method of the soil on the ratio level.

MATERIAL AND METHODS

The only method of determining the ratio level consists in the effectuation of the ratio between the mass of the soil particles with dimensions smaller than 5 cm, which are passed through a sieve of 5/5 cm filtration and the total mass of the sample. This method allows the determination of the ratio level of the soil, but is extremely expensive (CANARACHE A, 1990).

The research in cause has as a purpose the identification of the technical means of optimal mechanisation used in the small-sized and medium-sized nurseries, which are meant to lead to an increase of work productivity, a rise of the qualitative level of the processing and a reduction of the costs implied by saplings.

The purpose of the research is scientifically motivated through the necessity of introducing new tools for the execution of the works implied for soil preparation and obtaining a high ratio level of the soil in the small-sized and medium-sized nurseries.

So as to trigger the achievement of the purpose mentioned-above, there were established the following main objectives:

- the determination of the influence of different methods of soil processing on the ratio level;

- the parallel analysis of the influence of the processing system on the ratio level.

The ratio level is very important for the life of the saplings and plays a major role in their following growth. Starting with the germination and ending with the harvest of the saplings, the ratio level represents the initial vital space in the development of the seeds, together with the humidity, the heat and the air. (GUŞ P., RUSU T., 2003)

For this reason, a rapid, expeditious, but precise method was conceived which helped to determine the ratio level.

The work algorithm used for the study of the ratio level of the soil was applied in two variants: a base variant which served at determining this parameter after the soil processing with: the plough with lamellar mouldboard, the disc harrow, the combinator and the paraplow; and a second variant which implied supplementary methods for the particular study of soils processed with a harrow.

In figure1, there are chosen the light coloured surfaces which illustrate the "cutting" area of the clod by the active organ of the mechanical aggregate, with which the plough was done, and very accurately approximate its transversal surface and the clod's dimension.

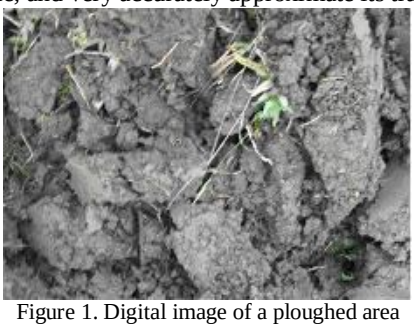

Figure 1. Digital image of a ploughed area

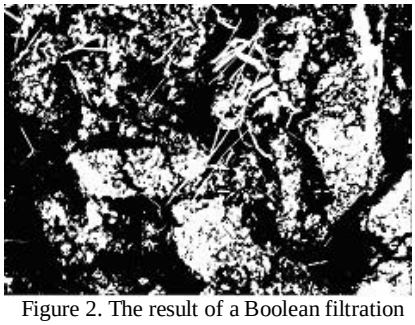

Figure 2. The result of a Boolean filtration

The separation of the "light" surfaces from the "dark" ones is achieved through a digital filtration defined by the relation:

$$Img\_BW_{i,j} = \begin{cases} 0, L_{i,j} \in [0;141] \\ 255, L_{i,j} \in [142;255] \end{cases}$$

which has as a result a matrix defined by two Boolean colours with the values „255" (white) – "light" surfaces – and „0" (black) – "dark" surfaces– represented in figure 2.

Next, the clods of soil will be indexed, and their surfaces and the indexation with random colours for the qualitative delimitation of the clods of soil will be measured.

In the case in which the majority of clods have relatively small dimensions, like in the processing with the harrow, their image will have a symmetrical and bipolarized distribution

near the colours with low and high intensity.

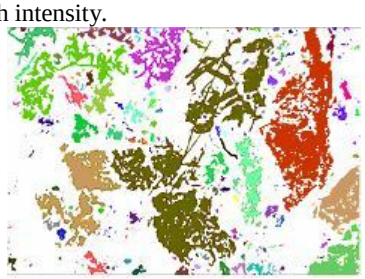

Figure 3. Qualitative delimitation with random colours of the "light" surfaces

The separation of the images with high density of colours starts with the filtration of the initial image by 8 bits (256 grey nuances) with the aid of a binarized image (white and black) obtained from the process of filtration with the threshold 172. Thus, an image of 8 bits with grey nuances is obtained, even though it has black delimitating outlines.

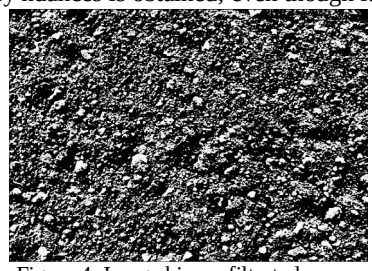

Figure 4. Image binary filtrated

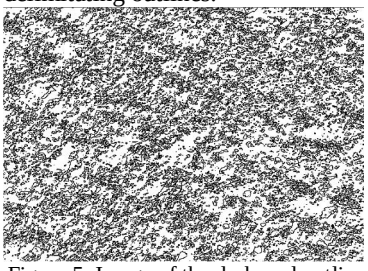

Figure 5. Image of the darkened outlines

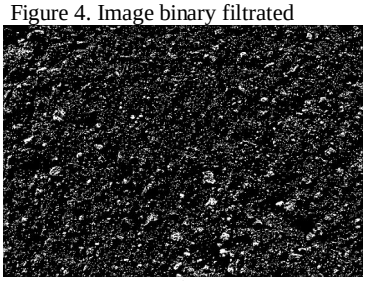

Figure 6. Image of the darkened clods

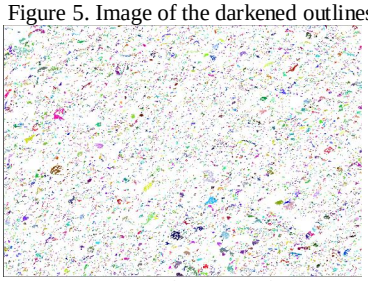

Figure 7. Image of the classified clods

The image of the clods with darkened outlines is subjected to the classification algorithm which leads to the surfaces in the figure 6 with palette of 2 bits (white and black).

The convex hull function, which will take each clod and it will circumscribe it to a convex polygon, will be applied to improve the precision for the determination of the surfaces of the clods. As it can be seen in the figure 7, the convex surfaces which define the clods are much more realist in shape and colour.

RESULTS AND DISCUSSIONS

In order to establish the ratio level both in classical system and in minimum system, five repetitions were made after each technical processing, by taking a photograph of the minced soil on a surface almost equal to $1m^2$. In view to statistically interpret the results, the arithmetical mean ($\bar{x}$), the standard deviation (s), the variation coefficient (S%) and standard

error of the mean ($S_{\bar{x}}$) were calculated.

The results of the research regarding the determination of the ration level based on the algorithm (method) described are presented in table 1, after the soil processing in classical system, and in table 2 for its processing in minimum system.

The graphical representation of the values obtained appears in figure 1 for the classical system and in figure 2 for the minimum system.

Table 1

Average values obtained after the determination of the ratio level in a classical system

Symbol of standard surface		Standard surface	Total number of clod	Total surface of the clod	Percentage of covering	Extreme values of surface of the clod		Amplitude of variation. w
Code		mm^2	n_i buc	mm^2	%	X_{max} mm^2	X_{min} mm^2	mm^2
Soil processed with a classical plough								
Statistical Indexes	$\bar{n}$	5.00						
	$\bar{x}$	764041.40	97	378034.15	49.96	108813.05	119.40	108693.65
	s	41875.50	25.17	116268.49	17.03	94521.52	35.51	94501.82
	S%	5.48	26.01	30.76	34.09	86.87	29.74	86.94
	$S_{\bar{x}}$	18694.42	11.24	51905.58	7.60	42197.11	15.85	42188.31
Soil processed with a disc harrow								
Statistical Indexes	$\bar{n}$	5.00						
	$\bar{x}$	774833.85	176	238170.80	31.00	17598.85	124.05	17474.80
	s	30879.20	11.56	88863.87	12.68	13338.69	14.46	13348.83
	S%	3.99	6.56	37.31	40.89	75.79	11.66	76.39
	$S_{\bar{x}}$	13785.4	5.2	39671.4	5.7	5954.8	6.5	5959.3
Soil processed with a harvester								
Statistical Indexes	$\bar{n}$	5.00						
	$\bar{x}$	773201	217	90010.05	11.64	10317.00	31.70	10285.30
	s	17862	5.86	8677.58	1.00	3739.16	18.64	3740.97
	S%	2.31	2.69	9.64	8.56	36.24	58.81	36.37
	$S_{\bar{x}}$	7974.2	2.6	3873.9	0.4	1669.3	8.3	1670.1

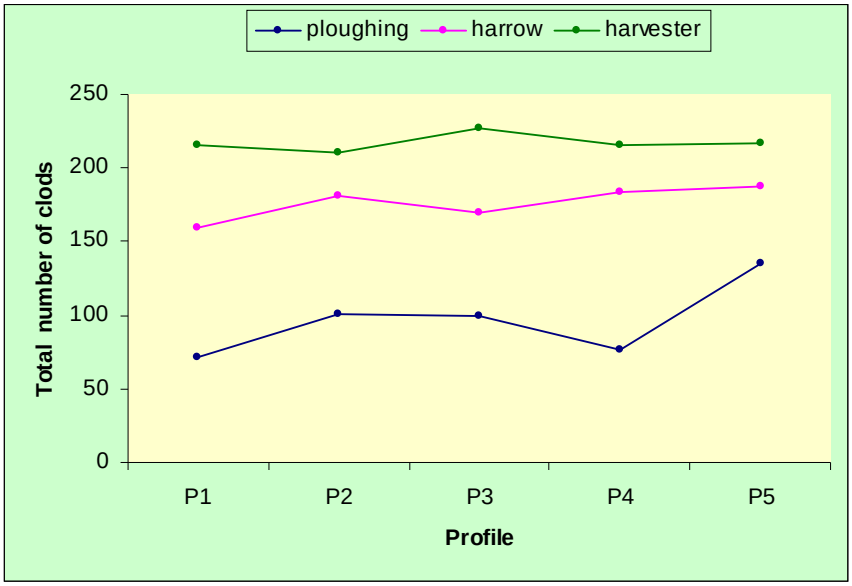

Figure 8. Variation of the number of clods resulted from the soil processing in classical system tillage

Table 2

Average values obtained after the determination of the ratio level in a minimum system

Symbol of standard surface		Standard surface	Total number of clods	Total surface of the clods	Percentage of covering	Extreme values of surface of the clods		Amplitude of variation. w
Code		mm^2	n_i buc	mm^2	%	X_{max} mm^2	X_{min} mm^2	mm^2
Soil processed with a paraplow								
Statistical Indexes	$\bar{n}$	5.00						
	$\bar{x}$	967872	12	407054.65	42.06	20173.05	1129.30	19043.76
	s	0.00	4.82	77721.61	8.03	33.99	21.31	12.68
	S%	0.00	39.48	19.09	19.09	0.17	1.89	0.07
	$S_{\bar{x}}$	0.00	2.15	34697.15	3.58	15.18	9.52	5.66
Soil processed with a rotary harrow								
Statistical Indexes	$\bar{n}$	5.00						
	$\bar{x}$	967872	577	146233.85	15.11	3032.15	33.45	2998.70
	s	0.00	56.47	34992.77	3.62	1117.99	16.67	1113.95
	S%	0.00	9.78	23.93	23.93	36.87	49.83	37.15
	$S_{\bar{x}}$	0.0	23.0	14282.8	1.5	456.3	6.8	454.7

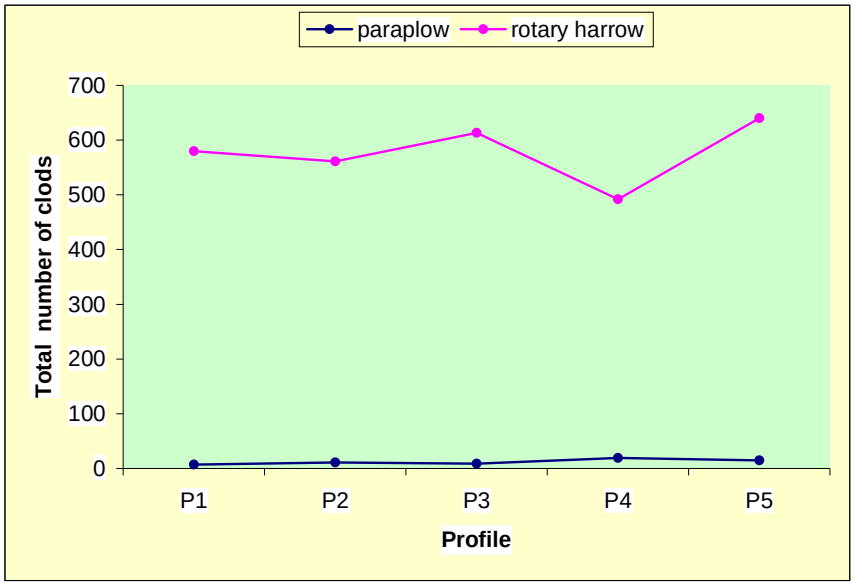

Figure 9. Variation of the number of clods resulted from the soil processing in a minimum system tillage

CONCLUSIONS

Analyzing the results obtained, it can be inferred that the ratio level has the highest value in the minimum system after the soil processing with a rotary harrow. In the classical system, the highest values of the ratio level were recorded after the soil processing with the harvester.

The utility of this paper is justified by the research data collected, processed, analyzed and made valuable in order to offer a pertinent material for study, which could be thus used by the specialists in the projection of the process of preparation of the germination bed according to the chosen processing system.

From the analysis of the results obtained during the research carried on and presented here, we may distinguish some original contributions in the domain of soil processing and in the way of determining the ratio level in the process of preparation of the germination bed.

The novelty degree refers to the fact that this physical indicator may be very easily determined by the simple taking of a photo of the processed soil and by monitoring the chosen algorithm.

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