STUDIES REGARDING THE TECHNICAL AND OPERATIONAL CHARACTERISTICS OF THE SCARIFIED AGGREGATE

F. MLADIN, G. VĂCĂRESCU, Anișoara DUMA COPCEA, Casiana MIHUȚ
University of Life Sciences "King Mihai I " from Timisoara, 300645, 119 Calea Aradului, Romania, Phone: +40256277001, Fax:+40256200296
Corresponding author:anisoaradumacopcea@usvt.ro, casiana_mihut@usvt.ro

Abstract. *The purpose of this work is to study the technical characteristics of an aggregate to be scarified under the conditions of the classic soil processing system. When preparing the land for plowing, the following operations will be performed:*
- checking and removing the causes that can cause the creation of unfavorable conditions for the work of the machines;
- the delimitation of return zones and the choice of the most efficient methods of travel;
- dividing the land into plots and marking the line for the first crossing. For the performance of mechanized works, the plots are chosen in such a way as to ensure the work for a longer time, without switching to other plots. The minimum plot size must ensure work on at least one shift. After choosing the direction of travel, the turning areas are demarcated at the ends of the plot. At the beginning, the turning area is delimited by stakes, after which a furrow is drawn to a depth of 6 - 8 cm. These traces show the place where the scarifier was moved into the transport and working position. Return areas are worked after the work on the plot is finished. The concept of soil conservation includes a set of activities, measures and technologies that compete to maintain the state of soil fertility without significantly reducing harvests or without high costs. This concept arose from the considerations that the land is the most important means of human existence that ensures the obtaining of food products, raw materials for the energy industry, etc. and consequently maintaining the biological capacity is a necessity imposed by the existence of social life.

Keywords*: scarified aggregate, soil, processing system, fertility*

INTRODUCTION

The contemporary world and especially agricultural specialists are increasingly aware of the fact that agriculture is an important source of regenerative energy for the economy, but at the same time it is also a large consumer of energy. [ANIȘOARA DUMA COPCEA și colab., 2023].

In this context, the mechanical processing of the soil by traditional methods is questioned today by more and more people due to the high energy consumption and the continuous degradation of the arable soil through erosion and excessive settlement. [CASIANA MIHUȚ și colab., 2022]. The classic tillage system, in addition to the special contributions to social progress, also brought serious damage to the environment and even its vital resources, continuously decreasing soil fertility. [CASIANA MIHUȚ și colab., 2022, CASIANA MIHUȚ și colab., 2023].

Soil conservation technologies were imposed by certain practical needs, especially of an economic nature, and their rapid expansion, especially in the United States and Canada, was due to the indisputable advantages compared to classic technologies, among which: reduction of water and wind erosion, increasing organic matter and natural soil fertility, reducing compaction, reducing production costs, reducing fuel and labor consumption. [VLAD DRAGOSLAV MIRCOV și colab.2023]. This system covers a wide range of methods whose primary purpose is to keep plant residues on the surface of the arable soil to reduce erosion. [LUCIAN DUMITRU NIȚĂ și colab., 2023, NIȚĂ L., și colab., 2018, CASIANA MIHUȚ și colab., 2023].

Increasing costs, increased ecological requirements, decreasing profits and problems related to plowing, have led to the increase of cultivated land surfaces in soil conservation technologies. [CASIANA MIHUȚ și colab., 2022, CARMEN CLAUDIA DURAU și colab., 2022].

Starting from some disadvantages of the classic processing system such as: deep settlement of the soil due to the repeated passing of the aggregates over the arable soil, the high cost of the works, the loss of organic substances, an attempt was made to replace the technologies and machines related to this system with machines that to carry out several works in one pass or the replacement and abandonment of certain works. [DAVID, SAIDA FEIER și colab., 2020, NICOLETA MATEOC-SÎRB și colab.2020].

The technological peculiarities of soil processing in the conservation system can be defined as follows:

- soil tillage operations are reduced to a minimum, by reducing the number of machines;
-soil settlement is reduced by reducing the number of passes and work operations;
- the effect of erosion due to water and wind is reduced, by leaving plant remains on the soil surface;
- the layer of vegetable remains determines the preservation of soil moisture due to the reduction of water losses through evaporation; [LUCIAN DUMITRU NIȚĂ și colab., 2023, NIȚĂ L, 2018].
- the method is much faster than conventional works, offers great fuel savings, working hours and investments in agricultural equipment;
-increases the capacity of water infiltration into the soil due to the layer of plant residues that slows down the flow of water on the soil surface, thus increasing the infiltration time;
- the physical structure of the soil improves, the humus content increases over time and the biological activity develops. [CASIANA DOINA MIHUT și colab., 2022, CASIANA MIHUȚ și colab., 2023].

Technologies with reduced work, those with minimal work and generally soil conservation technologies are applied by farmers in countries with advanced agriculture on large areas. The working organs of the machines used in the technology with minimal soil work are chisel-type loosening organs. By applying these processing methods, an average consumption of energy and labor is achieved in relation to the classic system. [CASIANA MIHUȚ și colab., 2023, LATO A.M și colab., 2020].

Taking into account these considerations, the technology of minimum soil works for the cultivation of grass cereals includes the following mechanized works: scarification, land preparation and sowing of grass cereals**.** [LATO, K. I., și colab., 2019].

MATERIAL AND METHODS

The technological sheet for operating the aggregate includes the following indicators: working conditions (land characteristics), agrotechnical requirements, indications regarding the characteristics of the aggregate and its preparation for work, land preparation for work, indicators regarding work organization and work quality control. The working regime is established taking into account the load of the engine and the tractor.

The technological sheet also includes the most important indicators of the organization of the technological process (duration of the travel cycle, worked surface and fuel consumption per hectare).

The 100 ha plowed area has the following dimensions:

- length 1000 m;
- width 1000 m.

The plowing work with the PP-3.30 plow will be carried out by moving the aggregates along linear paths, using the methods of plowing with the tiller and in parts by alternating the plots. The returns at the ends of the plot will be made with a loop and at 900.

The technical characteristics of the Gaspardo Artiglio Magnum 500/5 scarifier

The scarifier Artiglio Magnum 500/5 by Maschio Gaspardo is intended for deep loosening of the soil up to a depth of 50 cm. Works in aggregate with the Challenger MT-765B tractor.

The technical characteristics of the Artiglio Magnum 500/5 scarifier are:

- working width: 3.0 m;
-maximum working depth: 50 cm;
- mass: 1550 kg;
-number of loosening knives: 5 pcs.;
- working width of a knife: 40 cm
- no. of rows of anchors: 2 rows;
- the distance between the sowing rows: 65 cm;
-distance between coulters per row: 75 cm;
- three-point grip (scarifier worn);
- drive power: 250-300 HP.

CALCULATION AND FORMATION OF SCARIFIED AGGREGATES

The machine's resistance to scarification is:

$$R_m = K_0 \cdot a \cdot b \cdot n = 5 \cdot 10^3 \cdot 0{,}2 \cdot 0{,}23 \cdot 33 = 8250 \text{ daN},$$

where: K_0 is the soil's resistance to scarification (for medium soil $K_0 = 5 \cdot 10^3 \text{ daN/m}^2$)

a - working depth - ($a = 0{,}2\ m$)

b - the working width of a knife ($b = 36\ cm$)

n - no. of scarifier knives ($n = 11\ buc$)

Working speed

Comparing the aggregate's resistance to scarification with the traction force that the John Deere 8285R tractor can develop, the 7th speed gear is chosen with which the scarification work will be carried out. The working speed will be:

$$v_1 = v_t(1-\delta) = 2{,}3(1-0{,}1) = 2{,}07 \text{ m/s} = 7{,}4 \text{ km/h}.$$

The working capacity of the aggregate to be scarified

The real hourly working capacity is calculated with the relationship:

$$W_h^r = 0{,}1 \cdot B_l \cdot v_l \cdot K_s = 0{,}1 \cdot 5 \cdot 7{,}4 \cdot 0{,}8 = 2{,}96\ ha/h,$$

in which: B_1 is the working width ($B_l = 5{,}0\ m$)

v_1 is the working speed ($v_1 = 7{,}4$ km/h)

K_s is the coefficient of use of working time ($K_s = 0{,}8$)

The real work capacity per shift is calculated with the relationship:

$$W_{sch}^r = W_h^r \cdot T_s = 2{,}96 \cdot 8 = 23{,}68\ ha/sch.$$

The number of aggregates to be scarified is calculated with the relationship:

$$n_a = \frac{S}{W_{sch}^r \cdot n_z \cdot n_s} = \frac{100}{23{,}68 \cdot 4 \cdot 1} = 1{,}05$$

A scarified aggregate will be used to carry out the work in 4 days.
The area to be scarified of 100 ha has the following dimensions:
- length 1000 m;
- width 1000 m.

The scarifying work will be carried out by moving the aggregate according to the method in the pile. The minimum plot size must ensure work on at least one shift.

The land intended for scarification is divided into plots. Number of parcels n_p is calculated with the relationship:

$$n_p = \frac{S}{W_{sch}^r} = \frac{100}{23{,}68} = \approx 4 \text{ plots.}$$

The width of a parcel will be:

$$l = \frac{S}{L \cdot n_p} = \frac{1000000\, m^2}{1000\, m \cdot 4} = 250\, m$$

Where is the length of the plot (1000 m).
The width of the return zone is calculated with the relation:

$$\mathrm{E} = 3 \cdot \mathrm{R} = 3 \cdot 15 = 45 \text{ m}$$

Where is the turning radius of the aggregate.

Length of travel in work L_l is calculated with the relationship:

$$L_l = L - 2 \cdot E = 910 \text{ m}$$

Average idle travel length L_g is calculated with the relationship:

$$L_g = 3 \cdot R = 3 \cdot 15 + = 45\, m.$$

Considering $v_l = v_g$, the duration of a cycle will be:

$$T_c = \frac{L_l \cdot n_l}{v_l} + \frac{L_g \cdot n_g}{v_g} = \frac{(910 + 45) \cdot 2}{2{,}07} = 922\, sec.$$

The theoretical surface worked after one cycle is determined with the relation:

$$W_c = \frac{L_l \cdot n_l \cdot B_l}{10^4} = \frac{910 \cdot 2 \cdot 5{,}0}{10000} = 0{,}91\, ha / ciclu.$$

The theoretical hourly working capacity will be:

$$W_h = 3600 \cdot \frac{W_c}{T_c} = 3600 \cdot \frac{0{,}91}{922} = 3{,}56\, ha / h.$$

Fuel consumption per hectare will be

$$C_{ha} = \frac{C_h}{W_h} = \frac{54\, l / h}{3{,}56\, ha / h} = 15\, litri / ha.$$

RESULTS AND DISCUSSIONS

Calculation of economic indices

The economic indices assume both the knowledge of the consumption per surface unit and of the expenses per hectare, by elements of expenses.

The consumption of hours/aggregate is estimated with the help of the coefficient C_a , calculated with the relation:

$$C_a = \frac{T_s}{W_{sch}^r} = \frac{8}{23{,}68} = 0{,}34 \text{ hours-aggregate/ha}$$

Coefficient C_m , for servicing the aggregate is calculated according to the coefficient C_a and the number of workers, with the relationship:

$$C_m = C_a \cdot m = 0{,}34 \text{ man-hours/ha}$$

The production costs for carrying out a mechanized agricultural work are composed of indirect costs and direct costs.
Indirect expenses are those incurred for the performance of several mechanized works or in the general interest of the enterprise. Indirect expenses are recorded separately and then, according to certain criteria, the share is distributed for each mechanized work.
Direct expenses are those that are determined directly and are included in the cost of each mechanized work. In assessing the economic efficiency of an agricultural aggregate, only the indicator of direct expenses is used, because it expresses the reduction of labor and material expenses by using the respective agricultural aggregate. Direct expenses are expressed in lei/ha.

Direct expenses C_d is calculated with the relationship:

$$C_d = C_S + C_c + C_A + C_{dt}$$

in which:

C_S - are the expenses for remunerations;

C_c - fuel expenses;

C_A - depreciation expenses;

C_{dt} - expenses for the technical servicing of the aggregate.

Remuneration expenses are expressed according to the hourly tariff salary S_h and the coefficient C_m . The salary of a mechanist is approx 2000 lei/month. For a number of 22 working days/month, respectively 176 h/ month, which corresponds to an hourly rate of 11 /h. The costs for remuneration per hectare will be:

$$C_S = C_m \cdot S = 0{,}34 \cdot 11 = 3{,}7 \text{ lei/ha.}$$

Fuel costs are determined based on fuel consumption G_{ha} (liters/work unit) and the fuel cost p_1 (lei/ liter), that is:

$$C_c = G_{ha} \cdot p_i = 15 \cdot 6{,}5 = 97 \text{ lei/ha}$$

Expenses for aggregate depreciation C_A it is calculated both for the tractor and for the scarifier, taking into account the initial value of the aggregate V_i and, respectively, the residual value of the aggregate V_r , of shift work capacity W_{sch}^r, of the number of exchanges

n_s, of the number of days worked in a year n_z and length of service D expressed in years, that is:

$$C_{Atractor} = \frac{V_i - V_r}{W_{sch}^r \cdot n_s \cdot n_z \cdot D} = \frac{500000}{23{,}68 \cdot 250 \cdot 10} = 7 \text{ lei/ha}$$

$$C_{Aplug} = \frac{V_i - V_r}{W_{sch}^r \cdot n_s \cdot n_z \cdot D} = \frac{200000}{23{,}68 \cdot 250 \cdot 8} = 3 \text{ lei/ha}$$

$$C_A = 7 + 3 = 10 \text{ lei/ha.}$$

The expenses for the technical servicing of the aggregate C_{dt} are: expenses for technical maintenance, expenses for technical revisions and expenses for repairs. These expenses are determined throughout the service life of the tractors and machines in the aggregate. For the tractor, the technical service expenses are calculated with the relationship:

$$C_{dttractor} = \frac{V_i \cdot G_{ha}}{C_n} = \frac{500000 \cdot 10}{900000} = 5{,}3 \text{ lei/ha}$$

in which:

V_i represents the inventory value, in lei;

C_n - standard fuel consumption during service, in liters;

C_{ha} - fuel consumption per hectare in liters.

For the plow, the technical service expenses are calculated with the relationship:

$$C_{dtscarificator} = \frac{V_i}{W_n} = \frac{200000}{70000} = 3 \text{ lei/ha}$$

in which: V_i represents the inventory value, in lei;

W_n - the volume of work during the service period, in hectares.

important G_n şi W_n they were determined experimentally and are found in the maintenance, overhaul and repair technologies of tractors and agricultural machines. The expenses for the technical servicing of the aggregate are:

$C_{dt} = 5{,}3 + 3 = 8{,}3$ lei/ha.

The direct costs for a scarified hectare are:

$C_d = C_S + C_c + C_A + C_{dt} = 3{,}7 + 97 + 10 + 8{,}3 = 119$ lei/ha.

Ancillary expenses C_{ac} are expenses for main and auxiliary materials, expenses for the storage and preservation of tractors and agricultural machines. They are calculated as a percentage (15 – 20%) from direct expenses.

$C_{ac} = 0{,}2 \cdot 119 = 23$ lei/ha.

The total cost of a scarified hectare will be:

$C_T = C_d + C_{ac} = 119 + 23 = 142$ lei/ha.

The calculated technological indices are centralized in the technological sheet for the mechanization of the work to be scarified in the table 1.

Table 1

The technological sheet for the mechanization of the scarifying work
(expenses per scarified hectare)

Nr. crt	Economic indices		lei /ha
1	Direct expenses	C_d	**119**
	of which: - remunerations	C_S	3,7
	- fuels	C_C	97,0
	-depreciation	C_A	10,0
	-technical service	Cdt	8,3
2	Ancillary expenses	C_{ac}	**23**
3	**TOTAL**	C_T	**142**

CONCLUSIONS

The advantages of scarification compared to traditional plowing work are the substantial reduction of fuel consumption per hectare due to the greater working width, high productivity thanks to the superior working speed, high permeability of the soil. All this leads to the quantitative and qualitative increase of production against the background of reduced expenses.

It loosens the soil vertically, without inverting the layers, unlike plowing which, by turning the furrow, separates the soil layer from its natural support, the soil becoming an artificial body.

It achieves the breaking of hardpan and deeper impervious layers, ensuring easy infiltration and storage of water in the soil. The water from the precipitation does not drain to the surface of the soil, causing erosion, but accumulates in the soil.

It stimulates aeration and heating of the soil, intensifies the biological activity in the soil. In this way, the humification/mineralization processes are kept in balance, gradually providing the necessary nutrients for the plants.

Erosion and soil loss are reduced. The degree of loosening achieved by scarification ensures that water from precipitation does not drain to the soil surface, causing soil loss through erosion.

The loosening achieved by scarification ensures unimpeded root growth. Air penetrates more easily at the level of the roots and through the oxidation processes the energy necessary for the growth of the roots is provided.

It ensures the conservation of organic matter in the soil and the reduction of CO_2 emissions. The process of decomposition of organic matter occurs gradually with the formation of humus and nutrients, without forcing this process by intensifying the decomposition and mineralization of organic matter with CO_2 emissions.

Optimum soil porosity achieved by scarification keeps the humification/mineralization process in balance with the release of nutrients throughout plant growth and without excess nutrients that can be leached.

The scarification work has a higher productivity, it is carried out more easily than plowing, immobilizing the tractors less for this work.

Diesel consumption is lower, thereby reducing overheads while reducing pollution.

The activity and the cost of maintenance of the machines used in scarification are reduced. All this is reflected in lower expenses for obtaining crops, with maintaining and increasing soil fertility and without pollution.

BIBLIOGRAPHY

DAVID, SAIDA FEIER, MATEOC-SIRB, NICOLETA., MATEOC, T., BACĂU, CRISTINA, ANISOARA DUMA COPCEA, MIHUT, CASIANA, 2020, Agriculture and sustainable soil use in Timiş county, Romania, scientific papers series management, economic engineering in agriculture and rural development vol. 20, issue 1, 2020 PRINT ISSN 2284-7995, E-ISSN 2285-3952

DUMA COPCEA ANIȘOARA, CASIANA MIHUȚ, NICOLETA MATEOC-SÎRB, LUCIAN NIȚĂ, ADALBERT OKROS, IAROSLAV LAȚO, TEODOR MATEOC, DANIEL POPA, 2023, Studies on minimum wheat tilling, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 23, Issue 2, 2023 PRINT ISSN 2284-7995, E-ISSN 2285-3952

DURAU CARMEN CLAUDIA, CASIANA DOINA MIHUȚ, ANISOARA CLAUDIA DUMA-COPCEA, ADALBERT OKROS, VLAD DRAGOSLAV MIRCOV, 2022, Appreciation on biodiversity in several permanent grasslands in Timis county, Romania. A case study, Conference: 22nd SGEM International Multidisciplinary Scientific GeoConference 2022, DOI: 10.5593/sgem2022V/6.2/s25.10

LATO A.M., OANA SUCIU, CRISTINA PETRESCU, BRIGITHA VLAICU, MATILDA RADULESCU, ADINA BERBECEA, ISIDORA RADULOV, IAROSLAV LATO, 2016 - Evaluation of nitrates and nitrites content in some vegetables, Abstracts / Journal of Biotechnology 239S 1–3.

LATO, K. I., POPA, M., LATO, A., CORCHES, M.,RADULOV, I., BERBECEA, A., CRISTA, F., 2019, Economic efficiency of main soil types from West region of Romania for various Research Journal of Agricultural Science, 54 (4), 2022; ISSN: 2668-926X 129 agricultural crops, Journal of Environmental Protection and Ecology, 20(2): 1022–1028.

MATEOC-SÎRB[1]NICOLETA, CRISTINA-VIORICA BACĂU[1], ANIȘOARA DUMA COPCEA[1] , TEODOR MATEOC-SÎRB[1] , CAMELIA MĂNESCU[1] , SIMONA NIȚĂ[1] , OANA SICOE-MURG[1] AND GABRIEL SUSTER[1], 2020, Agricultural trends in Romania in the context of the current trends of the world economy, Journal of Applied Life Sciences and Environment Vol. 55, Issue 3 (191) / 2022: 335-350 https://jurnalalse.com, https://doi.org/10.46909/alse-552068

MIHUT CASIANA DOINA; ANIȘOARA CLAUDIA DUMA - COPCEA; ADALBERT OKROS; CARMEN CLAUDIA DURAU; ANTOANELA LENA COZMA, 2022. Conservative tillage soil systems in context of the climate changes. Proceedings of 22nd International Multidisciplinary Scientific GeoConference SGEM Vienna 2022. DOI: 10.5593/sgem2022V/4.2/s19.28. Issue 10.5593/sgem2022V/4.2 ISSN 1314-2704; ISBN 978-619-7603-50-7 Volume 22 Issue 4.2

MIHUȚ CASIANA, ANIȘOARA DUMA COPCEA, VEACESLAV MAZARE, ADALBERT OKROS, ROMINA MAZARE, 2023, The soils of the Remetea Mare locality for a sustainable use, 23rd SGEM International Multidisciplinary Scientific GeoConference 2023, DOI: 10.5593/sgem2023/3.1/s13.37

MIHUȚ CASIANA, ANIȘOARA DUMA COPCEA; ANTOANELA COZMA; VLAD DRAGOSLAV MIRCOV; DANIELA SCEDEI, 2023, Limiting factors and measures to restore soil fertility in the town of Biled, Timiș county, 23rd SGEM International Multidisciplinary Scientific GeoConference 2023, DOI: 10.5593/sgem2023/3.1/s13.31

MIHUȚ CASIANA, NICOLETA MATEOC-SÎRB, ANIȘOARA DUMA COPCEA, LUCIAN NIȚĂ, VALERIA CIOLAC, ADALBERT OKROS A., DANIEL POPA, 2022, Assessment of soil quality limitative factors. A case study: Secaş, Timiş county, Romania, Scientific Papers

Series Management, Economic Engineering in Agriculture and Rural Development Vol. 22, Issue 1, 2022 PRINT ISSN 2284-7995, E-ISSN 2285-3952

MIHUȚ CASIANA, NICOLETA MATEOC-SÎRB, ANIȘOARA DUMA COPCEA, LUCIAN NIȚĂ, ADALBERT OKROS, SIMONA NIȚĂ, TEODOR MATEOC-SÎRB, VLAD MIRCOV, 2022, Assessment of fertilization plans on basic crops. A case study. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 22, Issue 4, 2022 PRINT ISSN 2284-7995, E-ISSN 2285-3952

MIHUȚ CASIANA, NICOLETA MATEOC-SÎRB, ANIȘOARA DUMA COPCEA, SIMONA NIȚĂ, IAROSLAV LAȚO, VALERIA CIOLAC, ANTOANELA COZMA, ADALBERT OKROS, 2023, Assessing the state of fertility (quality) of the soils for sustainable agriculture in Remetea Mare, Timis county, Romania, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 23, Issue 2, 2023 PRINT ISSN 2284-7995, E-ISSN 2285-3952

MIHUȚ CASIANA; VALERIA CIOLAC; ANIȘOARA DUMA COPCEA; ADALBERT OKROS; DANIELA SCEDEI, 2022, Analysis of the influence of pedogenesis factors on soil formation using modern methods, 22nd International Multidisciplinary Scientific GeoConference SGEM 2022, DOI 10.5593/sgem2022/3.1/s13.27, ISSN 1314-2704, ISBN 978-619-7603-42-2

MIRCOV VLAD DRAGOSLAV; ADALBERT OKROS; CASIANA DOINA MIHUT; ANIȘOARA DUMA COPCEA; CODRUȚA CHIȘ, 2023, Interpretation of climate risk factors for the period 2019-2022 in the western area of Romania, 23rd SGEM International Multidisciplinary Scientific GeoConference 2023, DOI: 10.5593/sgem2023/4.1/s19.38.

NITA L., ADIA GROZAV, GHE. ROGOBETE, 2019 - Natural and Anthropic Soil Acidification in the West of Romania, Jurnal revista de Chimie Volumul 70 Numărul 6 Pagini 2237-2240 Editor Chiminform Data Sa.

NIȚĂ L., D ȚĂRĂU, Ghe. ROGOBETE, Ghe DAVID, D DICU, Simona NIȚĂ, 2018 - Using pedologic information in defining the quality and sustainable use of land in Western Romania, Jurnal Research Journal of Agricultural Science, Volumul 50, Numărul 1. OKROS A., 2015 - Fertility status of soils in western part of Romania, Journal of Biotechnology, Volume 208, Supplement, 20 August 2015, -09.05.2015 Bucuresti Romania 3,14.

NIȚĂ LUCIAN DUMITRU, DORIN ȚĂRĂU, GHEORGHE ROGOBETE, FLORIN CRISTA, SIMONA NIȚĂ, KAREL IAROSLAV LAȚO, ANIȘOARA DUMA COPCEA, ALINA LAȚO, ADALBERT OKROS, 2023, Physical-geographical and socio-economic conditions defining the quality of the eco-pedological resources in the timişoara metropolitan area, Scientific Papers. Series A. Agronomy, Vol. LXVI, No. 1, 2023 ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785