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AGROTECHNICAL CHARACTERIZATION OF LANDS FROM THE SOMEŞAN PLATEAU FOR AGRICULTURAL SUSTAINABILITY

Teodor RUSU[1], Bogdan Matei DUDA[1], Paula Ioana MORARU[1], Ileana BOGDAN[1], Lech Wojciech SZAJDAK[2], Adrian Ioan POP[1], Mihai Avram MAXIM[1], Ioan Aurel CHERECHEŞ[3]

[1]University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca, 3-5 Manastur Street, 400372, Cluj-Napoca, Romania
[2]Institute for Agricultural and Forest Environment, Polish Academy of Sciences, 19 Bukowska Street, 60-809, Poznan, Poland
[3]Technical University of Cluj-Napoca, 103-105 Muncii Blvd, 400641, Cluj-Napoca, Romania

Corresponding author email: trusu@usamvcluj.ro

Abstract

The agrotechnical characterization of lands from the Someșan Plateau targets the knowledge of their restrictions and limitations with the purpose to determine the needs and possibilities of increasing the production capacity, under the conditions of a durable agriculture. The purpose of the paper is the technological characterization of lands and the specification of agrotechnical measures to set up durable agricultural technologies, the determination of indices of characterization of rain aggressiveness (Fournier Index, Modified Fournier Index, Angot Pluviometric Index), of the best sowing time and the amount of active biological temperatures, as well as the degree of water ensurance of plants during the vegetation period. Monitoring and variability of climate elements was achieved during 2014-2018, through a network of 10 HOBO microstations, which store soil temperature data electronically (at 10, 30, 50 cm deep) and air (at 1 m hight), soil moisture (at 10 cm depth) and rain gauges. According to the values of the Fournier Index, 31.81% of the soils fit in low risk of rain erosivity. At the same time, the values of the Modified Fournier Index in most of the stations are between 90-120 and fit in a moderate rain risk of aggressiveness. The percentage analysis of the values of this index shows that 12.5% of the values crorespond to a low rain risk of aggressiveness, 58.33% of the values correspond to a moderate rain risk of aggressiveness and 29.16% of the values correspond to a high rain risk of aggressiveness. From the percentage analysis of averages of monthly values of the Angot Index it results that 54.9% of the values are subunit and 45.1% of the values are over unity, indicating the fact that drought intervals prevail over rain ones. The analysis of the best sowing time leads to the recommendation to maintain the reference intervals for the Someșan Playeau, thus: maize, 10-25 April; potato, 10-30 March; clover, 1-10 March. An increase of the amount of active biological degrees and the need to remake the zoning of favorability conditions for certain crops, according to the new microclimate conditions of the area is registered. When it comes to the degree of water ensurance of plants during the vegetation period for the main crops, one can notice that during 2014-2018, in the case of spring row crops, the water need was ensured during an optimal interval of 57.14% from the vegetation period in the case of maize, of 53.49% in the case of potato, of 53.57% in the case of clover and of 47.67% in the case of wheat.

Key words*: climate indicators, agricultural sustainability, Someșan Plateau.*

INTRODUCTION

The agro-technical characterization of lands targets the knowledge of their restrictions and limitations, with the purpose to determine the needs and possibilities of increasing the production capacity, under the conditions of a durable agriculture. The set up of regional studies, well-documented scientifically, is imperative, taking into consideration the measures to adapt to climate changes and the durable land management.

It is well-known that agriculture is one of the activity sectors sensitive to the variability of climate factors and especially to extreme weather events (drought, floods, storms), considered as significant risk factors influencing negatively both vegetal and animal production. The regional distribution of the impact of climate changes on agricultural production can vary a lot (Donatelli et al., 2012). Thus, for the southern part of Europe, some of the biggest decreases of crops are foreseen, of almost 25%, by 2080 under the conditions of a temperature rise by 5.4°C (Ciscar et al., 2011). Under these conditions, Bindi and Olesen (2011) also take into account, an increase of the risk of failure, especially in the case of unirrigated summer crops.

In the Romanian National Strategy on climate changes 2013-2020, set up by the Ministry of Environment and Climate Changes (2013), it is mentioned that the temperate climate shall be significantly changed within the next 50-100 years. The average daily rate of rainfalls shall be reduced by approximately 20%, foreseeing that they will be in a larger quantity for short periods of time and on reduced surfaces, which can lead to an increase of flood frequency, especially of flash floods, soil and ecosystem degradation. This rainfall predictability varies a lot, from one region to another, according to geographical parameters. The information on the future agrometeorological conditions shall be important in evaluating the impact of climate changes and in the development of adequate strategies to reduce and adapt to climate changes, the policies regarding the land use and in investigating the potential economical responses (Rivington et al., 2013).

The phenomena of dryness and drought generated by the lack of rainfall, tropical heat waves, associated with dry winds, are the most complex climate risks possible in any season which lead to the depletion of the water reserve in the soil, the appearance of the pedological drought, with negative effects upon plant metabolism and, consequently, to drops of the vegetal production (Bogdan, 2005; Povară & Văduva, 2009). The measures which can limit and counteract the drought effects can be applied both locally or regionally, and they can be adapted based on the features of the geographical area and the pedoclimate conditions, where the application of these measures is imposed. Such measures refer to (Rusu et al., 2017): the use of a biological material which is resistant to hydric and thermal stress; the use of agro-technical measures favorable to accumulate, preserve and effectively value water coming from rainfall; the use of a conservative agricultural system based on the protection of soil and avoidance of desertification; identifying areas vulnerable to climate changes and using biological material with biological features and pedoclimate demands specific to the new climate tendencies of the areas vulnerable to climate risks.

The purpose of the paper is the technological characterization of lands and the specification of agro-technical measures to set up durable agricultural technologies, the determination of indices of characterization of rain aggressiveness (Fournier Index, Modified Fournier Index, Angot Pluviometric Index), of the best sowing time and the amount of active biological temperatures, as well as the degree of water ensurance of plants during the vegetation period. The need to determine these indices comes from the existing situation in the agriculture from the Someșan Plateau, where, due to inadequate tillage systems, one can notice a series of negative aspects regarding soil fertility, the quantity and quality of the productions obtained. In this region, accelerated erosivity is not only the result of combined processes of two neotectonic movements (the uplift of the hill compartment and local subsidence), but also of the friability of geological formations, over which a wrong use of lands overlaps.

MATERIALS AND METHODS

Monitoring and variability of climatic elements, from the Someșan Plateau,was achieved during 2014-2018, through a network of 10 HOBO-MAN-H21-002 (On-set Computer Corp., Bourne, MA, USA) stations which store soil temperature data electronically (at 10, 30, 50 cm deep) and air (at 1 m hight), soil moisture (at 10 cm depth) and rain gauges. HOBO Smart Temp (S-TMB-M002) temperature sensors and Decagon EC-5 (S-SMC-M005) moisture sensors were connected to HOBO Micro Stations. Additionally, tipping bucket rain gauges (RG3-M) were deployed to measure rainfall. Data was downloaded from the Micro Stations every four months via laptop computer using HOBOware Pro Software Version 3.7.2. Soil types, land slope and exposition, altitude and geographical coordinates of the locations in which stations were set are shown in Table 1 (Duda, 2018).

How to use the lands and the degree of soil vegetation cover are the most important factors affecting the intensity and the frequency of surface erosivity following the action of rainfall (García-Ruiz, 2010; Nunes et al., 2011; Marin et al., 2015). The soil erosivity, under all its aspects, is one of the restrictive factors with repercussions on the agricultural production, its quality, and last but not least on the production costs, which results in the need to apply the best practices in the use of agricultural lands. The assessment of rain aggressiveness upon the sublayer, respectively fitting the lands in classes with a certain potential of erosivity as well as the susceptibility regarding the start of slope processes can be determined with indices calculated based on the pluviometric regime of the area researched (De Luís et al., 2009; Blaga, 2013).

Table 1. Configuration of stations in the Someșan Plateau

No. Station	Locality (County)	Altitude (m)	Soil type	Exposition	Slope, %
1	Cristorel (Cluj)	404	Preluvosol	N	8-10
2	Borșa (Cluj)	332	Faeoziom	S	2-3
3	Lelești (Bistrița-Năsăud)	606	Regosol	V	25-26
4	Șomcutu Mic (Cluj)	271	Aluviosol	S	2-3
5	Căprioara (Cluj)	416	Preluvosol	S	4-5
6	Almașu (Sălaj)	323	Aluviosol	S	8-10
7	Racâș (Sălaj)	253	Preluvosol	S-E	2-3
8	Șimișna (Sălaj)	256	Preluvosol	N-E	7-9
9	Ileanda (Sălaj)	225	Aluviosol	S	2-3
10	Bunești (Cluj)	209	Preluvosol	N	6-8

The rainfall regime reflects the aggressiveness of rain erosivity on the soil by their volume, duration and intensitaty, their effect is much more stronger when they appear after a long period of drought (Costea, 2012) and which, directly or indirectly, represent the main climate-genetic factor involved in a wide range of geomorphic processes and phenomena (Arghiuș, 2010). The indices used in the analysis are: the Fournier Index (Fournier, 1960), the Modified Fournier Index (Arnoldus, 1980) and the Angot Pluviometric Index.

The Fournier Index (*FI*) uses entry data easily accessible, that is the quantity of rainfall from the rainiest month of the year and the annual quantity of rainfall. The calculation formula of this index is given by the report between these elements, therefore: $FI = Pm^2/P$, where, Pm - is the quantity of rainfall from the rainiest month of the year (mm); and P - the annual quantity of rainfall (mm). The expression analyzes the erosivity capacity by rainfall in a certain territory (Satmari, 2010). The erosivity potential can be characterized based on the K values of the FI (Satmari, 2010; Gabriels, 2006). The conceptual scale (Oduro-Afriyie, 1996) to assess the erosivity risk based on the FI is presented in Table 2 (Meddi, 2013).

Determination of Modified Fournier Index. For the study of degraded lands, a Modified version of the Fournier Index (MFI) by Arnoldus (1980) was introduced, with the following calculation formula:

$$F_M = \sum_{i=1}^{12} \frac{Pi^2}{P}$$

where: Pi - the average quantity of rainfall for month i (mm); P - annual average quantity of rainfall. The classes of rain aggressiveness based on MFI (Yuksel et al., 2008; Blaga, 2013; Meddi, 2013) are presented in Table 3.

Table 2. Evaluation of the risk of erosivity based on the Fournier Index

Class	Soil losses (t/ha/year)	Fournier Index (K)(mm)	Risk of erosivity
1	< 5	< 20	Very low
2	5-12	21-40	Low
3	12-50	41-60	Moderate
4	50-100	61-80	Severe
5	100-200	81-100	Highly severe
6	> 200	> 100	Extremely severe

Table 3. Classes of rain aggressiveness based on Modified Fournier Index (MFI)

Class	MFI	Rain aggressiveness
1	< 60	Very low
2	60-90	Low
3	90-120	Moderate
4	120-160	High
5	>160	Very high

Angot Pluviometric Index (API) is the mathematical expression of the report between the daily average quantity of rainfall in a month (real quantity of rainfall) and the multiannual average quantity, respectively the quantity which would have been its share in the case of uniform division of the quantity of annual rainfall during all days of the year. The poor periods or the surplus from a pluviometric point of view from within a year can be highlighted thanks to this index based on which one can make a delimitation between the droughty months and the rainy ones. Thus, one can highlight the rainy intervals (K>1) and the droughty intervals (K<1). According to the values obtained, the marks of *rainy month* for over unity values and *droughty month* for the subunit values were attributed. They are calculated based on the formula: $K = p/P$; $p = q/n$ and $P = Q/365$; where: q - daily average quantity of rainfall; n - monthly number of days; Q - annual average quantity of rainfall. $K = \frac{p}{q} = \frac{q/n}{Q/365} = \frac{365*q}{Q*n}$. On the whole, this formula highlights the climate shade of each month (the subunit values indicate the droughty months and the over unity ones indicate the rainy months). It can be plotted by using real values (the variation curve has a better accuracy) or generalized (granting the 0.5 value for all the months where the result was subunit and 5.5 for the over unity ones). Blaga (2013) states that based on the values (subunit or over unity) of this index, susceptibility classes were determined to start the slope processes, for linear erosivity processes or for floods. If the values of the API range between 1.0-1.5, there is a very low and low predisposition to start these erosivity processes. In case of values ranging between 1.5-2.0, this predisposition is average. When the values of the API exceed the 2.0 value, there are conditions to start the erosivity processes, and in case of values over 2.5, there are very favorable conditions to start the processes of slope and linear erosivity (Blaga, 2013).

Determination of the optimal sowing period for the main crops in the Someșan Plateau and of the amount of active biological temperatures gives us the possibility to check and compare the sowing periods stated in expert literature with the data resulted from field observations in order to make adequate technological recommendations, adapted to the current conditions in the field. The optimal sowing period differs according to the species cultivated, the types and hybrids cultivated, destination of the crop, orographic conditions of the crop area. The growing phases of the plants are influenced mainly by temperature, which is decisive for germination, therefore, at this stage, every crop plant needs a minimum germination temperature, based on which the crops are grouped in epochs and sowing emergencies (Table 4; Munteanu et al., 2014).

Table 4. The optimal sowing periods of main crops in the Someșan Plateau

Crop and optimum time of sowing in the Someșan Plateau	Optimal time of sowing in the Someșan Plateau	Temperature in soil at sowing depth, ^{0}C
Spring crops		
Epoch I, Emergency I - Clover	1-10.III.	1-3
Epoch I, Emergency II - Potato	10-30.III.	5-8
Epoch II, Emergency I - Maize	10-25.IV.	8-10
Autumn crop		
Wheat, triticale	20.IX.-15.X.	3

Determination of the amount of biological active degrees recorded for the main crops in the Someșan Plateau is calculated only for the vegetation period. In order for a plant to reach maturity, it needs a certain amount of heat expressed as a sum of active biological temperatures (ABT), during the whole vegetation period, based on the following formula: $\Sigma ABT = \Sigma(Tef\text{-}Tb)$; where, ΣABT - a sum of active biological temperatures recorded during the vegetation period (thermal constant); Tef – effective temperature expressed as daily average temperature, calculated as an average between the daily maximum temperature and the daily minimum temperature; Tb - basic temperature or the biological threshold (temperature below which there are no more visible growths).

The thermal constants for the main plants cultivated in the Someșan Plateau are presented in Table 5 (Munteanu et al., 2014).

Table 5. Thermal constants of the main crops

Crop	Thermal constants, °C
Wheat	1800-2300
Maize	1700-2500
Triticales	1200-1390
Potato	1500-3000
Clover	800-1100

The determination of the areas which have conditions of thermal stress during the vegetation season is one of the most important parameters regarding the agroclimate conditions of the area.

Determination of the ensurance degree with water for plants during the vegetation period for the main crops. In order to determine the best moisture period for plants (IOUP, %), when the development of plants is made accordingly, the soil capacity for water in the land (CC), the fading coefficient (CO) and the interval of active moisture (IUA) were previously determined.

The capacity for water in the land (CC) is the water at the plants' disposal without being lost by infiltration or evaporation (Rusu et al., 2012) and was determined by indirect method by using the formula: CC = CO + 10 in case of soils with clay-sand texture; +12 in case of soils with clay-argil texture; +13 in case of soils with argil texture; where, CO is the fading coefficient.

The fading coefficient (CO) was determined by the indirect method which is based on the existing correlation between the CO and the hygroscopicity coefficient (CH) by using the following formula: $CO\% = CH \times 1.47$; where: CO - the fading coefficient, %; CH - the hygroscopicity coefficient, %. The fading coefficient is the limit below which the plant development isn't possible due to the inaccesibility of water for plants, resulting in their permanent fading.

The interval of active moisture (IUA) is the main indicator of the potential water reserve of a soil and represents the interval corresponding to the moisture the soil can retain and have at the plants' disposal (Rusu et al., 2012). The values of IUA or of the capacity of useful water (CU_{IUA}) corresponding to this interval were obtained based on the formula: $CU_{IUA} = CC\text{-}CO$, where: CU_{IUA} - water capacity, %; CC - land capacity, %; CO - fading coefficient, %.

The best moisture interval for plants (IOUP) was calculated for the interval 60-90% of the IUA value in order to compare with the data recorded in the field of the soil moisture with a view to analyze the moisture need ensured during the vegetation period of the plants.

RESULTS AND DISCUSSIONS

The annual values of the **Fournier Index** calculated for the stations which have a pluviometer, during 2014-2018 ranged between 1.21 at Cristorel station in 2014 and 28.89 at Ileanda station in 2016. As for the distribution of quantities of monthly rainfall recorded at the stations placed in the Someșan Plateau (Table 6), one can notice that the highest quantities were recorded during June (Almașu and Cristorel - 2018; Ileanda - 2016 and 2018; Șomcutu Mic - 2015 and 2018) and September (Almașu and Bunești - 2015; Cristorel - 2015 and 2017; Ileanda - 2015 and 2017). During 2014-2018, the multiannual value of the FI ranges between 11.69 at Cristorel station and 20.85 at Ileanda station (Figure 1).

Table 6. Annual values of Fournier Index (mm) in the Someşan Plateau (2014-2018)

Year/station	Almaş	Buneşti	Cristorel	Ileanda	Şomcutu Mic
2014	18.66672	-	1.21116	-	4.92126
2015	18.97173	21.72168	3.543022	11.21995	20.3932
2016	18.14629	18.3996	9.453125	28.89284	19.102
2017	3.608182	12.0873	25.19018	21.41495	4.165643
2018	27.19145	-	19.05654	21.90851	19.12136
Average	17.31688	17.40286	11.69081	20.85906	13.54069

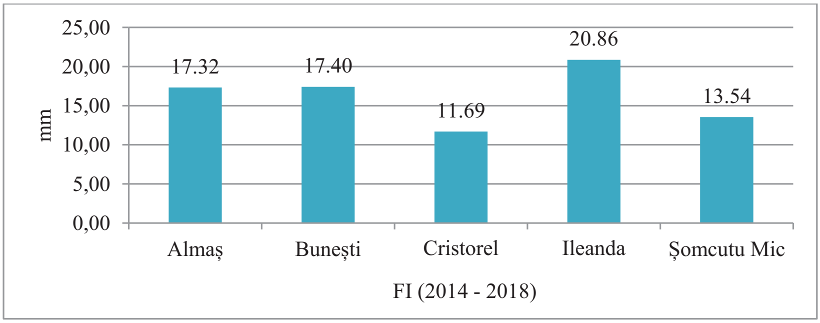

Figure 1. Multiannual value of Fournier Index (FI) from the Someşan Plateau (2014-2018)

In accordance with the values of the FI obtained during 2014-2018 (FI < 20) and of the erosivity classes, by using the Oduro-Afriyie conceptual scale (1996) with 6 classes of erosivity, the soils analyzed at the stations from the Someşan Plateau are submitted to a very low rain erosivity risk, being classified in class 1 of rain erosivity, with soil losses lower than 5 t/ha/year. A higher risk of erosivity was recorded in 2016 at Ileanda station, the FI value of which was bigger (28.89), classifying the soil in class 2 of erosivity, with soil losses ranging between 5-12 t/ha/year. Figure 2 shows the evolution of the K values of FI during 2014-2018 in the Someşan Plateau. From the analysis of the results obtained, one can notice that the FI values calculated reach high values, ranging between 21 and 60, sporadically at all 5 stations analyzed (2015 Buneşti, 2017 Cristorel, 2018 Şomcutu Mic).

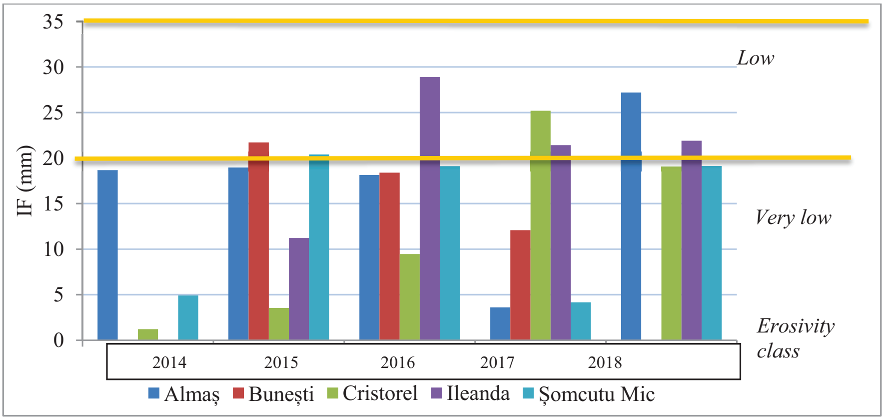

Figure 2. Annual values of FI and erosivity rainfall risk (2014-2018)

The multiannual average of the FI during 2014-2018 is 16.16, which classifies the soils from the Someşan Plateau in class 1, with very low risk of rain erosivity, with soil losses lower than 5 t/ha/year. The percentage analysis of the K values of FI calculated during 2014-2018 shows the fact that 68.19% of the soils fit into class 1, with very low risk of rain erosivity and 31.81%

of the soils fit into class 2, with low risk of rain erosivity.

Arnoldus (1980) considers that the **Modified Fournier Index** version (MFI), is an index which allows for a better approximation of the index of rain erosivity, with which it is in linear correlation (Meddi, 2013).The MFI values calculated during 2014-2018 range between 45, at Cristorel station in 2017 and 216.96 at Almașu station in 2014, in most stations all MFI values range under between 90-120, which, according to the classes of rain aggressiveness mostly used (Yuksel et al., 2008; Blaga, 2013; Meddi, 2013) the soils fit into class 2 and are submitted to a moderate risk of rain aggressiveness. Also, most of the multiannual values of MFI during 2014-2018 range between 90 and 120, the lowest are obtained at Bunești station (79.11) and the highest values at Almașu station (149.69) (Figure 3).

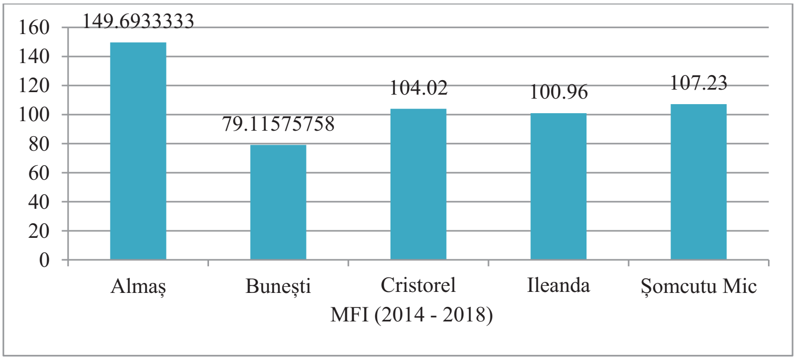

Figure 3. Multiannual value of MFI at stations located in the Someșan Plateau

The evolution of MFI values during 2014-2018 in the Someșan Plateau is represented in Figure 4. From the analysis of the results obtained, one can notice that the highest calculated values of MFI were obtained at Ileanda, Cristorel and Almașu stations during 2013-2015 and the lowest were obtained at Bunești and Cristorel during 2015-2018. The percentage analysis of MFI values calculated during 2014-2018 at the stations from the Someșan Plateau shows the fact that 12.5% of the values correspond to class 1, with low risk of rain aggressiveness, the values are lower than 60, and 58.33% of the values classify the soils in class 2, with moderate risk of rain aggressiveness, the values ranging between 90-120 according to the associated scales mostly used and mentioned in expert literature and the rest of 29.16% fit into class 3 of high risk.

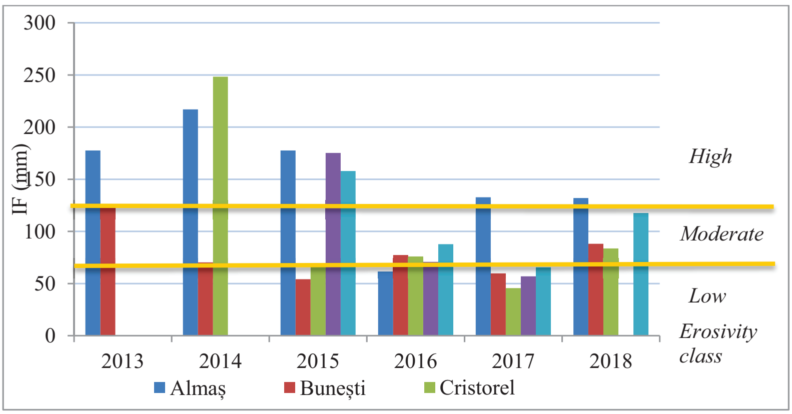

Figure 4. Annual values of MFI and erosivity rainfall risk (2013-2018)

Thus, following the analysis of MFI values calculated during 2014-2018, the conclusion is that most of the soils from the Someșan Plateau are submitted to a moderate risk of rain aggressiveness (58.33%) and to a high risk of rain aggressiveness (29.16%), differentiated based on the morpho-dynamic features of the space analyzed and the duration and intensity of rainfall from the period of time analyzed.

The Angot Pluviometric Index (API). From the analysis of the K values of the API for the stations from the Someșan Plateau which were equipped with a pluviometer, during 2014-2018, one can see subunit values during the summer and winter periods in most of the years and stations and over unity values during the spring and autumn months. The highest values over 2,00 of the API were recorded in 2015 and 2018, when in June it was recorded 2.29 and respectively 2.62. Based on the annual average, all stations have average values, approximately 1.01. The monthly averages of the values of the Angot pluviometric index at the stations analyzed from the Someșan Plateau are represented in Figure 5.

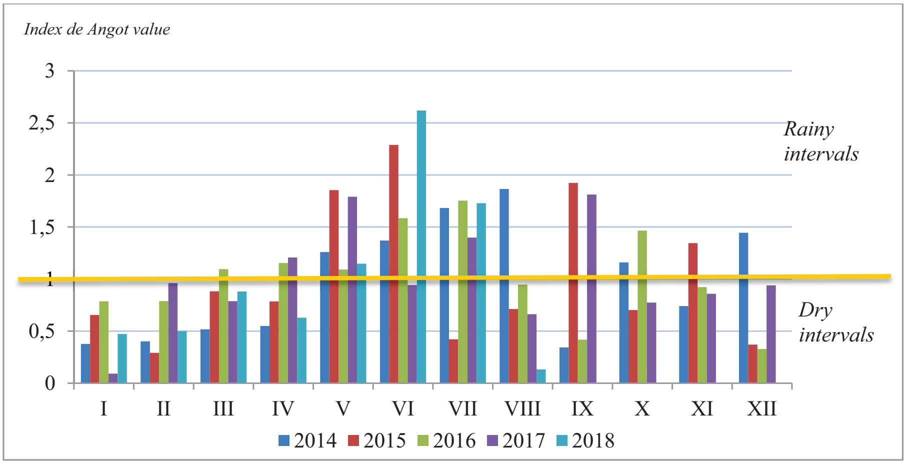

Figure 5. Monthly averages of Angot pluviometric index (2014-2018)

From the percentage analysis of the averages of monthly API values during 2014-2018, at the stations from the Someșan Plateau it results that 54.9% of the values are subunit, while 45.1% of the values are over unity, showing the fact that droughty intervals are predominant to rainy ones. The analysis of the correlation between the multiannual averages of the monthly average amount of rainfall and the multiannual averages of API during 2014-2018 shows a strong, positive and direct correlation between the two parameters, with a correlation coefficient R^2 of 0.77, which indicates the fact that 77% of the API values can be explained in linear relation to rainfall (Figure 6). The index value K >a 2 can highlight the existence of conditions to start slope and linear erosivity processes. During 2015 and 2018, according to the API values, the amount of rainfall was higher compared to the previous year, which indicates the creation of favorable conditions to start the slope and linear erosivity processes (Figure 7).

When it comes to the weight of predisposition in starting slope and linear erosivity processes based on the API values, one can notice that in 59% of the cases there is no risk of rain erosivity, in 21.42% of the cases there is a low and very low predisposition, in 16.07% of the cases favorable conditions to start the erosivity processes are created, and in 3.57% of the cases very favorable conditions of linear rain erosivity were created.

Determination of the optimal sowing period for the main crops in the Someșan Plateau. When establishing the best sowing time, one must take into account the minimum germination temperature of seeds and the amount of grades of useful temperature in every plant. Also, the orographic factors together with the agrometeorological parameters recorded in the crop areas, which refer to the first autumn frost and the last spring frost, temperatures higher than 32°C, the amplitude of temperatures during the summer months or those associated to the vegetation phenophases of plants and last but not least, the risk of developing of agricultural drought are important. Based on the results obtained following the analysis of data recorded in the Someșan Plateau during 2014-2018, one continues to recommend the reference intervals, thus: maize, 10-25 April; potato, 10-30 March; clover, 1-10 March.

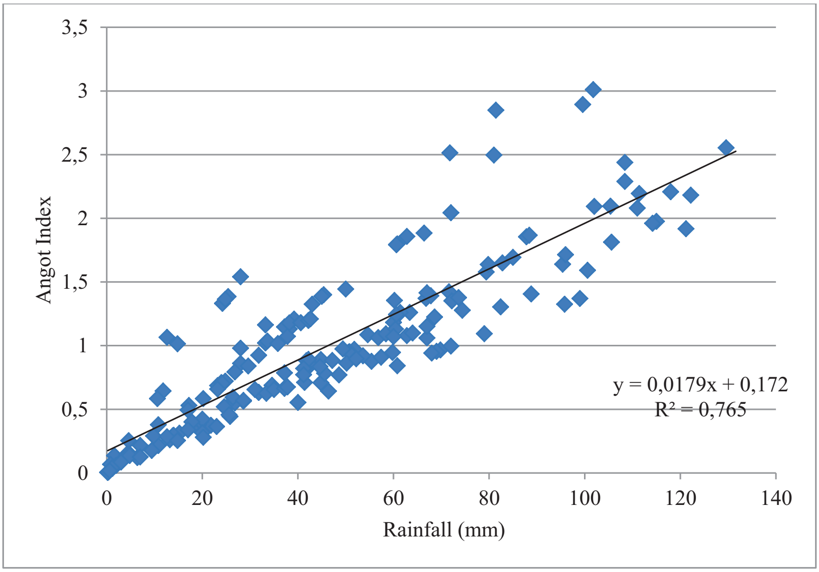

Figure 6. Correlation between the multiannual averages of monthly average quantities of rainfall and the multiannual averages of Angot pluviometric index (2014-2018)

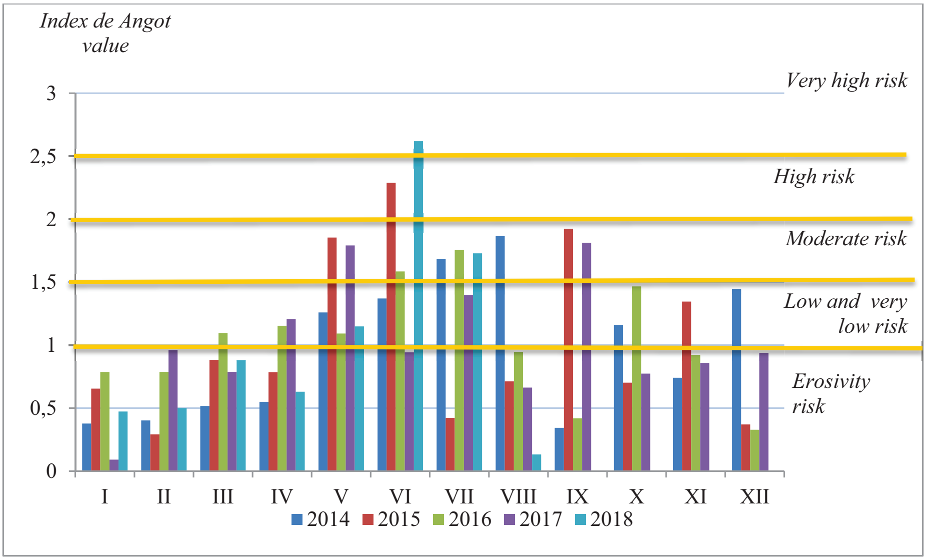

Figure 7. Monthly averages of Angot pluviometric index and the risk of rain erosivity (2014-2018)

The amount of biological active degrees (ABT) recorded for the main crops in the Someșan Plateau. For the calculation of ABT, the longest periods of vegetation, corresponding to the half-late and late types/hybrids in the crops analyzed were taken into consideration, thus: 290 days for autumn wheat (Almaș station) and 320 days the other stations, 180 and 210 days for maize and 180 days for potato. For the crops analyzed, in the case of wheat, during 2015-2017, average values of ABT were obtained, of 1831°C, the values ranging between 2017°C at the Bunești station in 2016 and 1712°C at Ileanda in 2017 (Table 7). These values are close to the need of temperature for the wheat crop mentioned in expert literature.

In the maize crop, during 2013-2018 one can notice that the amounts of active biological temperatures were ensured, which exceeded the limits set up for the III crop area, ensuring thus, the thermal need both for crop area II and for crop area I.

In the case of potato, a vegetation period of 180 days was taken into account, between 10 March and 26 September. During this interval average values of ABT of 1441°C were accumulated to ensure the need of reaching maturity of this crop. The values ranged between 1847°C, at Cristorelstation in 2013 and 1482°C, at Ileanda, 2016.

In the case of clover, on an average, 1683°C are insured, for a vegetation period ranging between 1 March and 30 September. The highest values were recorded at Cristorel, in 2016 (1865°C), and the lowest at Ileanda, in 2016 (1504°C), these values being almost 2 as high as the need of reaching maturity.

Table 7. Value of amount of biological active degrees registered at Almașu, Bunești, Cristorel, Ileanda and Șomcutu Mic for wheat, corn, potato, and cloverleaf (2015-2017)

Station	Year	Wheat/Triticale		Maize		Potato	Clover
		total	pre-winter				
		20.IX-06.VII/06.VIII		10.IV-08.X	10.III-08.X	10.III-26.IX	01.III-30.IX
Almaș	2015	1802,841	532,872	-	-	-	-
	2016	1909,8515	542,7455	1496,4105	1714,19	1517,4865	1735,3615
	2017	1813,579	520,068	1509,3985	1758,061	1506,5095	1776,189
Bunești	2015	1759,0835	430,382	1307,155	1510,1435	1331,1735	1528,252
	2016	2017,277	455,802	1457,2015	1706,26	1461,7415	1727,837
Cristorel	2013	1880,056	259,462	1582,509	1847,742	1587,093	1865,283
	2017	1713,109	438,298	1414,5885	1638,098	1416,0715	1654,7165
Ileanda	2015	1738,594	405,141	-	-	-	-
	2016	1984,185	420,375	1275,224	1482,968	1309,303	1504,486
	2017	1712,4975	416,137	1403,3075	1667,148	1420,9545	1694,12
Șomcutu Mic	2015	1753,877	437,1415	1554,971	1795,4135	1573,3125	1818,9835
	2016	1991,326	461,8135	1301,726	1511,9405	1325,0455	1531,3805
	2017	1733,3465	443,5655	1407,5895	1665,2005	1409,808	1685,67

The ensurance degree with water for plants during the vegetation period for the main crops in the Someșan Plateau. The best moisture time for friends (IOUP, %) is represented by the interval ranging between 60-90% of the active moisture interval (IUA), interval during which the development of plants runs accordingly. The percentage representation of the best moisture time for plants at the stations from the Someșan Plateau during 2014-2018 is showed in Figure 8. During 2014-2018, in the case of spring weeding crops, the need of water was ensured in an optimal interval of 57.14% from the vegetation period in the case of maize, of 53.49% in the case of potato, of 53.57% in the case of clover and of 47.67% in the case of wheat. During 2014-2018, one can notice an increase of extreme climate phenomena, represented by long drought periods correlated with reduced amount of rainfall, which leads to the reduction of the soil capacity to ensure constantly the optimum moisture for plants.

Special attention needs to be paid if the water deficit from the soil is associated to the drought periods during critical times with maximum demands of moisture and temperature, which have a bad influence upon the physiological processes of plants, resulting in decreases of their productivity. In this regard, it is necessary to apply some agricultural technologies which result in maintaining water in the soil, as well as irrigating the crops to ensure the best production potential of crops.

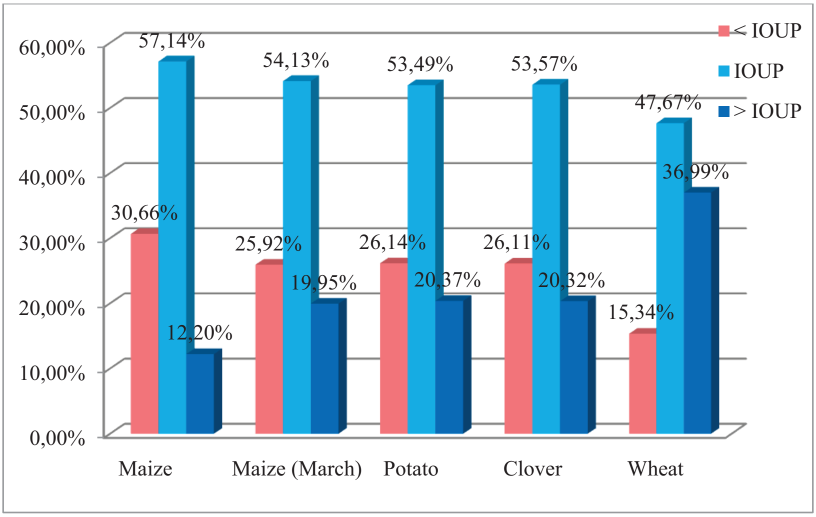

Figure 8. The optimum moisture range for plants (IOUP, %) (2014-2018)

CONCLUSIONS

The determination of the evaluation indices of rain aggressiveness upon the sublayer (Fournier Index, Modified Fournier Index and Angot Pluviometric Index) suggest favorable conditions for the appearance and development of rain erosivity processes. The effect is the more intense when they appear after a period of prolonged drought, especially in March, April, July and August or, in some cases, in October and November. This situation involves the application of some soil tillage systems which incorporate/maintain at surface the vegetral debris, especially during summer and autumn.

As for the degree of water ensuring of plants during the vegetation period for the main crops, one can notice that during 2014-2018, for the spring weeding crops, the water need was ensured during an optimal interval of 57.14% from the vegetation period in the case of maize, of 53.49% in the case of potato, of 53.57% in the case of clover and of 47.67% in the case of wheat. One can notice an increase of extreme climate phenomena, represented by long drought periods correlated with reduced amount of rainfall, which leads to the reduction of the soil capacity to ensure constantly the optimum moisture for plants. Therefore, ensuring irrigations during the droughty periods is a must, especially when temperatures are higher than 32°C, during June-August, which coincides with the critical period, with maximum demands of rainfall for the clover, wheat and maize crops.

The determinations of degrees of active biological temperature and their analysis during 2014-2018 recommend to take into account the cultivation of types and hybrids which best value the conditions from the Someșan Plateau, together with a remaking the zoning of favorability conditions for certain crops, according to the new microclimate conditions of the area.

Following the analysis of parameters regarding rainfall, temperature and soil moisture, we recommend to apply some technological measures which reduce the water losses from the soil and the increase of its reserve by conservative measures.

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