RESEARCH ON RETENTION CAPACITY OF PRECIPITATION BY CANOPY, CONSIDERING THE REDUCTION OF SOIL EROSION

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Abstract

The reintroduction of these soils into the forest circuit is one of the priorities of the foresters' present and future actions, the importance of these actions resulting of: prevention of the soil erosion and decay; maintain the soil destination category, the production capacity of the wood biomass, an element extremely important in economy; the carbon retention capacity; the creation of the forest specific microclimate, a factor extremely important from a socio-economic point of view. The results regarding canopy retentions were obtained by placing in situ several rain gauges with height of 25 cm and 100 cm^2. The precipitations retentions by canopy values were computed by the difference between the amount of rainfall recorded in open grounds and average values recorded at rain gauge installed in land cover with trees (in forest). Rains were grouped into classes, and the rainfall for each class being calculated as mean value of precipitation retained. The data obtained were highlighted with correlation between rainfall inside the forest and rainfall outside the forest. The curves of retention in the canopy layer were plot according to the height of rainfall and some characteristics of trees (species, age, consistency).The frequency of days with precipitation ranged from one month to another and from one season to another. The data set analyzed showed that rainfall triggered surface runoffs in seven day (5% of the total days computed).Based on the computed data were determined regression equations between the runoffs amount and precipitation quantity, also, between rainfalls quantity and standard deviation of previous monthly.

Key words: soil erosion, precipitation, surface drain, the canopy retention

INTRODUCTION

Forest influences, to the largest extent, the hydrological regime of a region and ensures a better preservation of the soil. This protective coating retains and preserves into the soil large quantities of rainfall water, regulates and reduces to the maximum the water drainage at the surface, protects the soil against erosion and preserves an equilibrated debit, relatively constant of the river waters. (Arghiriade, 1968).

Degraded soils become an important nowadays issue, especially within the context of the diminution of these surfaces covered by forest vegetation, at a national level. The reintroduction of these soils into the forest circuit is one of the priorities of the foresters' present and future actions, the importance of these actions resulting of: prevention of the soil erosion and decay; maintain the soil destination category, the production capacity of the wood biomass, an element extremely important in economy; the carbon retention capacity; the creation of the forest specific

microclimate, a factor extremely important from a socio-economic point of view.

In order to choose an optimal solution for the reintroduction, into the forest circuit, of a surface of decayed soil, one of the consecrated research methods is the study of the water retention into the canopy, as it represents the quantity of water retained by the tree canopy, dependant on the structure and on the features of the forest stands (species, age, consistency, the canopy quality, the foliar surface), whereas, on the other hand, it depends on the rain features (the rainfall quantity, the rainfall duration and the variation of its intensity) and on the atmospheric conditions at the moment of the rain fall.

According to the research performed by Abagiu in the years 1960, 1972, 1973, by Arghiriade 1960, by Ceuca, 1960, Munteanu, 1973, Gaspar, 1973 (Traci, 1985), the tree canopy can retain 5-12 mm water, during long-lasting rains up to 20 mm, while in litter it can be of 5-10 mm. The same values are given by Ciortuz and coworkers, (2004) according to whom the forest vegetation retains in its canopy up to approximately 15-20% of the annual rainfalls, if we refer to deciduous trees and with 25-30% if we refer to softwood stands.

MATERIAL AND METHOD

The study of the present research work was developed within the improvement perimeter of the Basin Valea Gurghiului, its total surface measuring 73 ha, extending over a number of 36 sample surfaces, of an area of 2000 sm, the total surface of the research area being of 10 ha, respectively approx. 13,7 % of the surface of the improvement surface. The emplacement method of the sample surfaces followed the grid method.
The types of the brush stands studied were mix brush stands, beech and spruce, the participation ratio being of variable percents within the arboretum under study. The species plantation method was the bio-group plantation.

In order to quantify the rainfalls value, a large number of plastic pluviometers were placed, equipped with the gradations: 1 mm/m rainfall = 1 liter/m and also handmade pluviometers made of plastic bottles, with a receiving surface of 100 cm^2.

In order to determine the quantity of the rainfall retained by the canopy pluviometers were also placed in open field, as a testimony alternative.

Measurements were taken during two vegetation seasons (2015 – 2016) during the period 15 March -15 November, to quantify only the liquid rainfall quantity.) The canopy retention value was calculated as the difference between the quantum of the rainfall registered in open field and

the average of the values registered by the pluviometers installed in the experimental lots inside the forest. So as to determine the variation of the rainfall retention by the brushes, of various structural features: composition, age, consistency, we placed the experimental surfaces as follows: The first sample surface area, respectively a number of 9, in the S of the improvement perimeter, where the brush stand has a composition of 7Fa 3Mo, aged 70, the consistency being of 0.8.

The second area of experimental surfaces, a number of 7 surfaces, was placed in the N of the perimeter, characterized by a composition of 8Fa 2Mo, aged 90, of a consistency of 0.6. The third sample surface group, numbering 9 surfaces, is placed in the E of the perimeter, having the following features: composition 7 Mo 3Fa, age 90 and consistency 0.7. The fourth battery of sample surfaces, numbering 11 lots, is placed in the S of the perimeter, characterized by a composition of 6 Mo 4Fa, age 100, consistency of 0,6.

Rainfalls were grouped in rainfall categories, and for each class of rainfalls the average of the rainfalls retained by the canopy was calculated. The information thus gathered was used to create graphics and correlations between the rainfalls of the open field and the rainfalls inside the forest.

Fig 1: Original photo

Fig 2: Original photo

RESULTS AND DISCUSSION

According to the information, the frequency of the rainfall days is approximately equal for the two years of the study, the smallest no. of rainfalls (109) registering in year 2015, while the largest (110) in year 2016. Distributed on months, the number of rainfall days differs from one year to the other. As shown in table 1, for the year 2015, the months with the largest number of rainfalls were the months of July, June, March, and the smallest in the month of September. In year 2016 the months with the largest number of rainfalls were October and May, whereas the smallest was in the months of July and August.

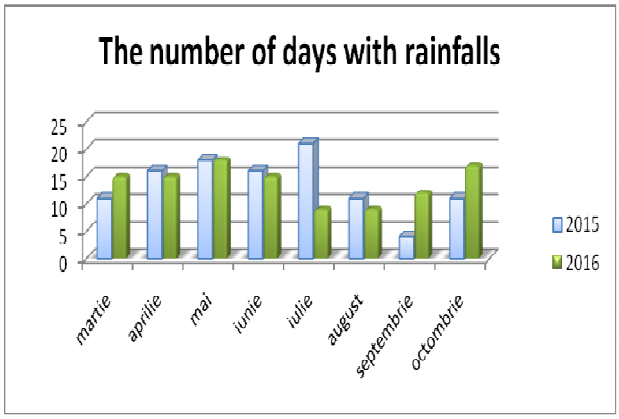

Fig 3. Number of days with precipitation

By analyzing the information related to the quantum of the rainfalls during the two years of research we could ascertain the following:
For the year 2015 at a daily level, the maximum quantum of rainfalls was registered on 17 March and was of approximately 23 mm while the most rainy was the month of July, the value of the rainfall registering approximately 154 mm; the most droughty was the month of September, which registered 4 days of rainfall (43 mm).

For the year 2016 at a daily level, the 1 maximum quantity of rainfalls was registered on June, the 17th and was of approximately 33.5 mm, while, at a monthly level, the biggest quantity of rainfalls was registered in June, the value being of approximately 149 mm, while the lowest quantity of rainfalls was registered in the month of July and was of approximately 29mm.

The canopy retention was studied for the mix brush stands, beech and spruce. As the study/observation duration was different (depending on the periods of emplacement a of the experimental surfaces), in order to compare and read the information, the rainfalls were grouped on rainfall categories, thus establishing both the average values (in mm), the retention values and the retention percentage for each category (table 1).

Table 1

Number of rainfalls registered and the retention in the stand consisting of:

The rainfall category (mm)	Number of rainfalls registered and their retention by the brush stands of:								
	Beech of consistency/age						3 Fa and 7 M0 of consistency/age		
	0,8/70			0,6/100			0,7/90		
	Number of events	Retention		Number of events	Retention		Number of events	Retention	
		mm	%		mm	%		mm	%
0-5	123	1.4	25	123	1.3	24	139	2.2	20.4
5-10	52	1.8	21	52	1.9	22	56	1.8	18.7
10-15	21	2.7	9	21	1.6	15	18	4.8	19.5
15-20	17	2.1	13	17	4.1	11	19	2	14.3
20-25	3	3.4	10	3	5.1	19	5	1.8	18.8
25-30	2	4.8	18	2	8.6	27	3	1	17.6
35-40	0	0	0	0	0	0	3	1,7	10.5
Total perioada	218		16	218		20	243		26

For the beech stands, where the interception was characterized by the same number of events, differences determined by the stand age and consistency were registered. Thus, the younger beech stands (70 years) of a lower consistency (0,8) retained only 16% of the fallen rains, as compared to the 20% percentage registered by the beech stands aged 100, registering a 0.6 consistency.

The smaller values registered in the first situation can be also explained by the fact that the stands in question have been subject to few maintenance works up to present, the stand canopy being unequally developed, whereas, from the point of view of the foliar mass presence it suffers because of its under-development. The mixture stands (beech and spruce) retained 26% of the rainfalls quantity. This high percentage is determined by the large number of pluvial events registered and also by the presence of the spruce, as it determines, by its foliar apparatus features a larger retention surface.

The result is close to the results of other research works (26%, Abagiu et al. 1973) developed under circumstances similar to those of our study (beech aged 70 and a 0.9 consistency).

The results thus obtained underline a quite important variation of the retention percent, as compared to the total quantity of the fallen rains. In an obvious manner, this variation (from 9 % to 27 %) is determined not only by the rainfall quantity, but also by other features of the rainfalls (intensity, duration, the canopy composition, the brush stands age, their consistency, etc.). We nevertheless consider the quantity influence essential, especially

considering that, following the increase of the class interval from 0 to 5 mm, we could achieve the differentiation between the three types of compositions of the experimental surfaces in terms of their capacity of retaining the rainfall water at the level of the canopy (fig. 4).

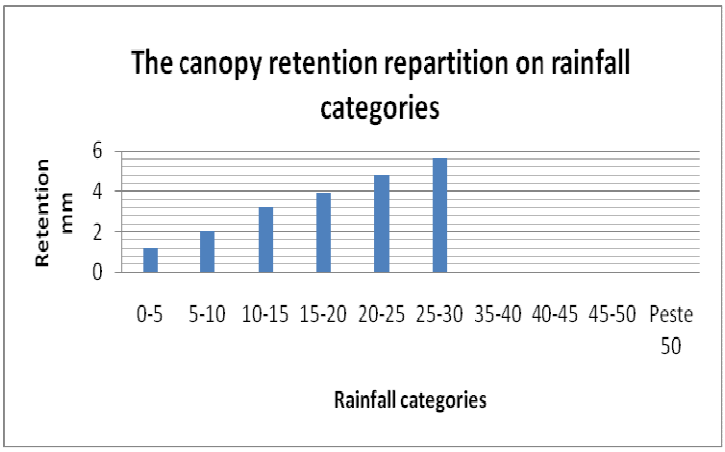

Fig 4.Distribution of retention in the canopy on classes of precipitation

We shall underline that the biggest quantity of rainfalls retained by the canopy was registered within the rainfall category 25-30 mm, followed by the category 20-25 mm, whereas the lowest value was registered with the rainfall category 0-5 mm. We shall also underline the fact that for the rainfall categories over 30 mm the retention was 0, due to the fact that within the period under research, only during one day rainfall values over 30 mm were registered.

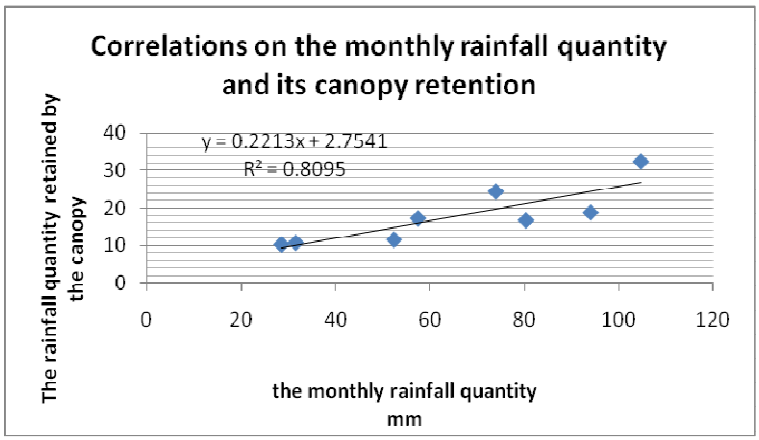

Fig 5. Correlations regarding the amount of monthly precipitation and the retention in the canopy

By analyzing the figure 5. We shall conclude that between the rainfall quantity retained by the canopy and the monthly rainfall quantity of year 2015, there is a direct and distinctly significant connection (r^2 = 0,7095), based on the equation of regression, at every 10 mm of the rain quantity fallen during year 2015, as the canopy retains a quantity of 2,6128 mm, respectively a percentage of approximately 26 % at the level of the entire brush stands under study.

CONCLUSIONS

For the two years during which the research studies were developed, the rainfalls registered variation of both the monthly quality fallen and of their intensity and frequency.

For the period March 2015 – October 2015, the cumulated duration of the rainfalls was of 108 days in which this phenomenon was signaled, 72% of them being short rainfalls.

The beech brush stands registered differences determined by the trees age and consistency.

The beech brush stands of younger age (70 years old) and lower consistency (0,8) retained only 16% of the fallen rains, as compared with the 20% percentage registered by the beech stands aged 100, of a 0.6 consistency.

The lower values registered in the first case can be explained by the fact that these brush stands have not been subject to works of maintenance.

Within the regions of the brush stands where the brush composition was of intimate mixture of beech and spruce, the rainfalls quantity was significantly higher during the period under research, mainly determined by the increase of the canopy retention surface by the spruce foliar apparatus which is a feature of the softwood.

The installed stand is administered in the same manner as the woods, all the trees falling within the same age category, the variables being given by their composition and consistency.

The exponential regression equations established, within the perimeter under research and during the two analyzed years, a direct and distinctly significant connection between the quantity of the rainfalls retained by the canopy and the quantity of the fallen rains.

The percentage of the rainfalls retained by the canopy registered by our research study was an average percentage of 16 % for the portion of the beech stands aged 70, of a 0,8, consistency ; 20 % for the portion of the beech stands aged 100, of a 0,6 consistency, whereas the highest retention

value was registered within the stands of the brushes where the composition was 7 Mo 3 Fa, the value thus registered being of 26%.

The optimal solution related to the regeneration composition of the studied brush stands refers to the insertion of the beech, based on the developed research works, the quantity of the water which reaches the soil and might generate erosion processes being the lowest in this case.

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