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The Study of the Quantitative Soil Looses Reported in the Experimental Field Located in Valea Mare de Criș, Bihor County

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Abstract

It is well known that both anthropogenic and natural factors affect in great measure the soil erosion. This creates difficulties in the exploitation of arable land, increases the frequency and severity of floods, accentuates the effects of the drought phenomenon, contributing to environmental pollution. The present study was carried out in order to identify the influence of erosion on maize production in a moderately degraded, sloping land. The research was carried out in the village of Valea Mare de Criș, which belongs to Borod commune, Bihor County, on an eroded land with a slope of 12, cultivated with corn belonging to the Pioneer PR38A24 hybrid. The experiments were carried out according to the randomized block method. The study of the productivity of the eroded land on the slope was carried out by quantifying the corn production corresponding to the use of four experimental variants. The highest maize yield averages are reported for contour cropping technology, both for the top of the slope (4.18 t/ha) and the base (5.01 t/ha). Strong and very strong correlations are identified between the maize productions recorded according to the experimental variant. It is found that the location of the crop at the base of the slope has the strongest influence on production.

Keywords: level curves, slope, statistics, versant.

1. Introduction

Erosion creates difficulties in the exploitation of arable land, increases the frequency and severity of floods, accentuates the effects of the drought phenomenon, also contributing to environmental pollution [3, 7]. The importance and particularities of fertilization on sloping land have been highlighted by a series of studies [1, 4, 5, 6]. Both anthropogenic and natural factors affect in great measure the soil erosion. The relief, through its elements (slope, length and shape of slopes, exposure, etc.) strongly influences soil erosion. The higher the slope, the higher the speed of the water and the force of displacement and transport of soil particles. Erosion is accentuated the longer the slope, because a greater amount of water accumulates and due to gravity, the speed increases. On the southern and western slopes there is lighter and heat, the snow melts faster, and soil erosion is stronger. Softer rocks are more quickly and easily eroded, while hard rocks are more resistant.

Deep erosion occurs mainly in clays, marls, limestones and very rarely in sands. Soil influences land erosion through its properties [2, 7]. The present study was carried out in order to identify the influence of erosion on maize

production in a moderately degraded, sloping land.

2. Material and Method

Research carried out in the village of Valea Mare de Criș, which belongs to Borod commune, Bihor County, on an eroded slope, with a slope value of 12, cultivated with corn belonging to the Pioneer PR38A24 hybrid. The experiments were carried out according to the method of randomized blocks, in three repetitions, each plot having an area of 50 m2. The study of the productivity of the eroded land on the slope was carried out by quantifying the corn production corresponding to the use of four experimental variants:

- cultivated with maize by level curves, peak
- cultivated with maize by level curves, base
- cultivated with maize by direction hill-valley, peak
- cultivated with maize by direction hill-valley, peak.

The statistical methods used refer to the use of the least squares method (LSD5%) for the calculation of the differences between the experimental variants at the 5% significance threshold [8]. Also, the components of the basic statistics were calculated, respectively the averages and the coefficients of variation, which highlight the representativeness of the averages and the homogeneity of the statistical analysis. Also, the statistical tool contributed to the calculation of simple Pearson correlations (due to the fact that the elimination criterion of linearity was met), in order to highlight the interrelationship between the studied parameters [8]. Another statistical tool used is represented by multivariate analysis, through its component Principal Factor Analysis (PCA), carried out in order to test the level of correlation of the variance of the main factors identified as influencing the indicators under study with each of the elements of interest characteristic of the study carried out. The STATISTICA v.8.0 for Windows program was used for statistical processing.

3. Results and Discussions

The results obtained in the experimental field on the eroded slope with a slope of 10% highlight statistically significant differences between the corn productions obtained at the base of the slope compared to the productions obtained at the top of the slope. The differences are greater in the situation where the corn was cultivated in the hill-valley direction and not in the direction of contour lines. According to the least squares test (LSD5%), statistically significant differences are recorded between the corn productions corresponding to the experimental variants (Table 1).

At the base of the slope, higher corn production averages are recorded, both for the location of the crop on contour lines (variant 2b, 5.01 t/ha) and in the hill-valley direction (variant 3b, 4.97 t/ha). Compared to the value recorded corresponding to variant 1, the differences are greater by 19.86% in the case of experimental variant 2 corresponding to the cultivation of corn on level curves at the base of the slope and by 19.86% in the case of experimental variant 3b corresponding to the cultivation of maize on the hill-valley direction at the base of the slope , while in the case of experimental variant 3 corresponding to the cultivation of corn on the hill-valley direction at the top of the slope, the production is lower by 11.96% compared to variant 1 (Table 1).

Table 1. The maize yield (t/ha) recorded in eroded arable field according to experimental variants, 2019 – 2020

Issue	t/ha	%
Experimental variant **1** cultivated with maize by level curves, peak	4.18b	100
Experimental variant **2** cultivated with maize by level curves, base	5.01b	119,86
Experimental variant **3** cultivated with maize by direction hill-valley, peak	3.68b	88,04
Experimental variant **4** cultivated with maize by direction hill-valley, base	4.97b	119,14
Media/Mean	4,46	
CV (%)	14,28	
$LSD_{5\%}$	11,344	
F	3,429*	

CV% – variation coefficient; LSD –Least Significant Differences; F –Fisher coefficient; the means with same letter are statistically insignificant; a - p > 0,05%; b – p > 0.05%.

In order to test the appropriateness of principal component analysis, the intensities of the correlations between the corn productions recorded according to the experimental variant

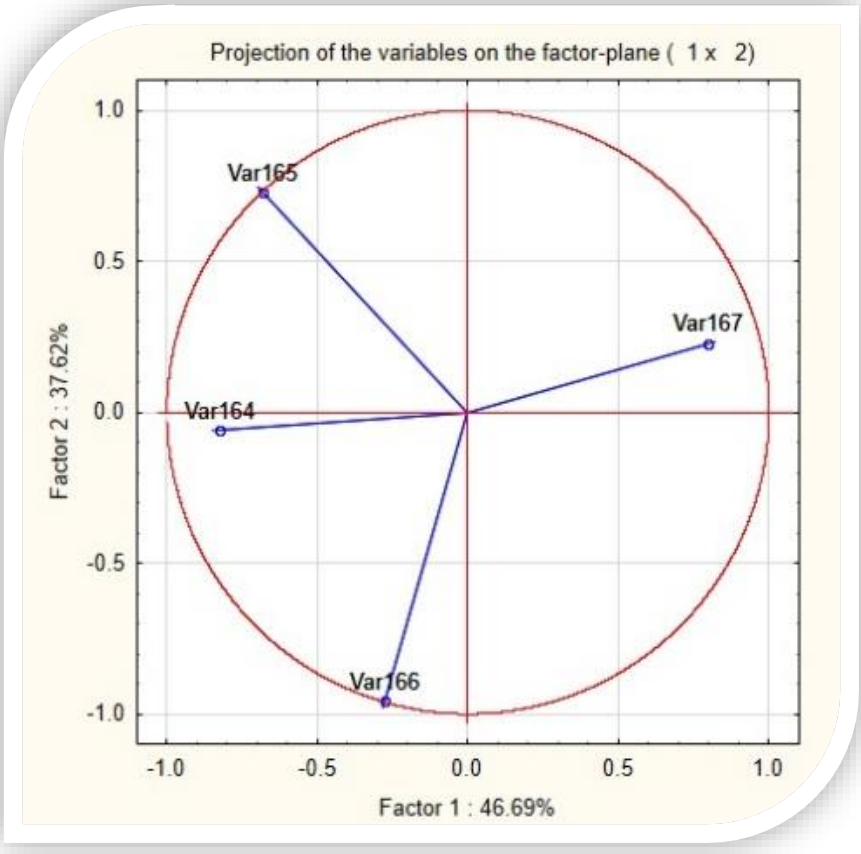
are calculated. Due to the fact that in most cases, the intensities of the correlations are strong and very strong (Table 2), we consider that the condition of conducting the principal components analysis is met. Four main factors influencing maize production are identified: experimental variant, location, crop and soil type. Due to the fact that only two of the four factors present Eigenvalues above unity, only these are considered (Fig. 1, Table 2).

The factor represented by the experimental variant is responsible for 46.66% of the variance, being positively correlated with the corn production obtained within the experimental variant 3b corresponding to the cultivation of corn on the hill-valley direction at the base of the slope, and the second factor, the location, is responsible for 37.67% of the variance, being positively correlated with the corn production obtained in experimental variants 2b and 3b, corresponding to the cultivation of corn at the base of the eroded slope in the slope, both in the direction of the level curves and in the hill-valley direction (Fig.1, Table 2).

Table 2. The simple correlations between the soil traits important for assessing the erosion level of sloping arable field according to experimental variants, 2019 – 2020

Issue	1	2	3
2	R=-0.256; R^2=0.043	R=0.578; R^2=0.942	R=0.783; R^2=0.842
3		R=-0.666; R^2=0.037	R=-0.419; R^2=0.149
4			R=0.401; R^2=0.669

R – correlation coefficient; R^2 – determination coefficient; Var 1 - Control experimental variant 1, meadow, peak; 1 - Control experimental variant 1, meadow, base; 2 –Variant cultivated with maize by level curves, peak; 3 – Variant cultivated with maize by level curves, base; 4 –Variant cultivated with maize by direction hill-valley, peak; 6 –Variant 3 cultivated with maize by direction hill-valley, base.



Var 164 Variant cultivated with maize by level curves, peak; Var 165 –Variant cultivated with maize by level curves, base; Var 166 –Variant cultivated with maize by direction hill-valley, peak; Var 167 –Variant 3 cultivated with maize by direction hill-valley, base

Figure 1. The projection of the variables involved in the study of the soil productivity of the principal factors PF1 and PF2

4. Conclusions

The highest maize production averages are reported for contour cropping technology, both for the top of the slope (4.18 t/ha) and for the base (5.01 t/ha), and the differences between productions both between those reported for the base and the top of the slope and compared to those related to the culture technology in the hill-valley direction are statistically ensured (LSD5%).

Strong and very strong correlations are identified between the maize productions recorded according to the experimental variant.

The same two main factors out of the total of four identified were taken into account as in the case of the physical-chemical indicators studied, namely the experimental variant and the location of the culture.

The experimental variant is the main factor positively correlated with the technology of corn cultivation in the hill-valley direction at the base of the slope and the location is the main factor correlated very strongly, positively, with the technology of cultivation on level curves, also at the base of the slope.

It is found that the location of the crop at the base of the slope has the strongest influence on production.

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