INFLUENCE OF SEED DIRECTION ON YIELD AND WATER USE EFFICIENCY AT MAIZE CROP IN THE CONDITION OF ERODED SLOPE FROM NORTH WESTERN PART OF ROMANIA

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Abstract

Growing maize from top to valley intensified the erosion phenomenon and the research in the leakage control plots located on a land with a slope of 10% at Agricultural Research and Development Station Oradea concerning on studying the influence of sowing direction on the maize yield. In 2012, sowing maize from top to valley compared with sowing on level curves direction determined a loss of yield by 2085 kg / ha. However, in variant sowing from top to valley difference of the yield obtained at base and the top of the slope registered is higher than sowing on level curves direction. In 2013 yield loss registered due sowing the direction from top to valley was 2180 kg / ha, and the difference between yield registered at the base of the slope and the top of slope was higher in maize sowing from top to the valley compared to variant sowing on level curves direction. Sowing maize on level curves direction provides better efficiency of water used, resulting an higher quantity of primary yield from 1 m^3 of water used.

Key words: *erosion, maize, , water use efficiency, yield, slope, level curves direction*

INTRODUCTION

Erosion is the process of detachment from the land surface of the soil or rock, their transport to the place of origin and put them elsewhere. Nationally, the great agronomist Gheorghe Ionescu Şişeşti, in 1925, in paper "The phenomenon of destruction and reconstruction of the soil" was the first to draw attention on damages caused by erosion to Romanian agriculture. Erosion creates difficulties in arable, increases the frequency and severity of floods, droughts are more pronounced, and the environment is polluted (Budoi, Penescu, 1966 Gus et al., 1998 Canarache, 2001).

Soil erosion is influenced by natural factors and anthropogenic factors: topography, geology field, soil.

Damages caused by erosion are soil degradation and loss of yield, difficulties in land use, flooding, increased drought and environmental pollution.

Efficiency of water used by plant or only irrigation water used efficiency, approaching the water issue from two perspectives: one that brings first the yield element, highlighting the quantity of product obtained in the consumption or use of 1 m^3 of water (Craciun , Nagy, Domuta C., etc.), while the second emphasizes the water factor, showing the quantity of

water consumed or used to obtain 1 kg of primary production (Botzan M., Grumeza, Domuta C., Tusa etc.). Water use efficiency varies from one culture to another and is influenced by climatic conditions and elements of technology.

MATERIAL AND METHOD

The researches regarding to soil erosion in the slope land and were effectuated at the Agricultural Research and Development Station Oradea in the leakage control plots located on a land with a slope of 10%. In the leakage control plots were studied following variants:

V1 - black fallow
V2 - maize seeded from top to valley
V3 - maize seeded on the level curves direction
V4 - wheat
V5 – clover

The yield of the maize from the base and the top of the hill has been determined in four repetitions in each position, and the limit differences were determined through analysis of variance (Domuta C., 2006).

Water use efficiency (WUE) was determined using the following formula:

$$WUE = \frac{Yield.}{\Sigma(e+t)}$$

In which:

WUE = water used efficiency, kg/m^3
Σ (e + t) = plants water consumption; m^3/ha

Higher values of the indicator show the superior efficiency of water consumed.

Efficiency of irrigation water used (EVAI) show the numbers units of gains yield obtained at one unit of irrigation water used.

$$IWUE = \frac{Yield \quad gain}{\sum m}$$

In which:

IWUE = irrigation water used efficiency, kg/m^3
Yield gain = Yield on irrigated crop – Yield on unirrigated crop
Σ m = irrigation rate; m^3/ha

Pedological drought was considered the decrease of the soil moisture bellow easily available content and strong pedological drought was considered the decrease of the soil moisture bellow wilting point (Domuta C., 2005; Brejea, 2011, 2014).

The depth used for soil water balance was 0-150 cm. Initial water reserve and final water reserve was calculated with formula:

$$Ri(Rf) = Ux\ BD\ x\ H$$

In which:

U = soil moisture, %

BD = bulk density, g/m^3

H = depth, cm

RESULTS AND DISCUSSION

The influence of erosion and direction of sowing on maize yield in 2012

Researches show a stronger differentiation between the yields obtained at the top of the slope compared to the base of the slope in condition of maize cultivation from top to the valley compared to maize sown on the level curves direction, 2460 kg / ha (67%) compared to 1700 kg / ha (39%). In both variants of maize the differences between yields obtained on the base of the hill versus top of the hill were very significant statistically (table 1, table 2).

Table 1

Influence of the position on the hill on maize yield in the variant sown from top to valley and on the level curves direction in the conditions from Oradea, 2012

Sowing variant	Position on hill	Yield		Difference		Statistically signification
		kg/ha	%	kg/ha	%	
From top to valley	Top	3790	100	-	-	Mt
	Base	6250	167	2460	67	***
$LSD_{5\%}$ 360 $LSD_{1\%}$680 $LSD_{0,1\%}$ 1240						
On the level curves direction	Top	4320	100	-	-	Mt
	Base	6020	139	1700	30	***
$LSD_{5\%}$310 $LSD_{1\%}$ 590 $LSD_{0,1\%}$ 950						

Table 2

Influence of sowing direction on maize yield in the conditions from Oradea, 2012

Sowing variant	Yield		Difference		Statistically signification
	kg/ha	%	kg/ha	%	
On the level curves direction	6135	100	-	-	Mt
From top to valley	4050	66	2085	-34	000

$LSD_{5\%}$ 210
$LSD_{1\%}$ 390
$LSD_{0,1\%}$ 640

The influence of erosion and direction of sowing on water used efficiency by maize in 2012

Soil water reserve determined at maize sowing had lower values compared with the top of the hill compared with base of the hill, both in variant sowed from top to the valley and variant sown on the level curves direction. Also at the top of the slope, the water reserve had a lower value at variant sowing from top to valley compared with variant sown on the level curves direction. The values of water used efficiency at maize sown at base and top of the hill was close to the both variants regarding to sown on the level curves direction (Table 3).

Table 3

Soil water balance (0-150 cm) in maize sown from top to valley and on level curves direction at the top and base of the hill, Oradea 2012

Position	Interval		Days number	Initial reserve	Rainfall	Total in soil	Final reserve	Total water consumption
	From	To						
Maize sown from top to valley								
Top	1.04.	20.09.	173	4620	2881	7501	3570	3931
Base	1.04.	20.09.	173	4870	2881	7751	3630	4121
Maize sown on the level curves direction								
Top	1.04.	20.09.	173	4730	2881	7611	3620	3991
Base	1.04.	20.09.	173	4860	2881	7741	3710	4031

For 1 m^3 of water used in the top of the hill was obtained 0,964 kg maize gain in variant sown from the top to the valley with 57% more in variant on the level curves direction. Between water uses efficiency determined at the base and top of the hill there is a greater difference in the variant sown from top to the valley compared with variant sown on the level curves direction, 57% vs. 38% (table 4).

In maize sowing on the curves level direction for 1 m^3 water used was obtained with 3% more yield compared to variant sown from top to valley (1,288kg / m^3 to 1,255 kg / m^3) (table 5).

Table 4

Influence of the position on the hill on the water use efficiency (EVA) in maize crop sown from top to valley and on level curves direction, Oradea 2012

Position	EVA		Difference
	Kg/m^3	%	%
Maize sown from top to valley			
Top	0,964	100	-
Base	1,517	157	57
Maize sown on the level curves direction			
Top	1,082	100	-
Base	1,493	138	38

Table 5

Influence of seed direction on water use efficiency (EVA) in maize crop, Oradea 2012

Seed direction	EVA		Difference
	Kg/m^3	%	%
From top to valley	1,255	100	-
On level curves direction	1,288	103	+3

The influence of erosion and direction of sowing on maize production in 2013

Researches show a stronger differentiation between the yields obtained at the top of the slope compared to the base of the slope in condition of maize cultivation from top to the valley compared to maize sown on the level curves direction

Between maize yield obtained at the base and top of the slope there were differences of 60% in maize sowing from top to the valley and 44% in

the variant sown on the level curves direction both highly statistically significant (table 6).

Table 6

Influence of the position on the hill on maize yield sown from top to valley and on the level curves direction in the conditions from Oradea, 2013

Sowing variant	Position on versant	Yield		Difference		Statistically signification
		kg/ha	%	kg/ha	%	
From top to valley	Top	4010	100	-	-	Mt
	Base	6420	160	2410	60	***
$LSD_{5\%}$ 160 $LSD_{1\%}$390 $LSD_{0,1\%}$ 680						
On the level curves direction	Top	4420	100	-	-	Mt
	Base	6370	144	1950	44	***
$LSD_{5\%}$ 210 $LSD_{1\%}$ 430 $LSD_{0,1\%}$ 790						

In average, the maize cultivated from top to valley registered a statistically significant loss of yield compared with maize sown on the level curves direction , it's value is 2180 kg / ha, very significant statistically (table 7).

Table 7

Influence of sowing direction on maize yield in the conditions from Oradea, 2013

Sowing variant	Yield		Difference		Statistically signification
	kg/ha	%	kg/ha	%	
On the level curves direction	6395	100	-	-	Mt
From top to valley	4215	66	2180	-34	000
$LSD_{5\%}$ 170 $LSD_{1\%}$ 330 $LSD_{0,1\%}$ 610					

The influence of erosion and direction of sowing on water used efficiency by maize in 2013

Soil water reserve determined at maize sowing had lower values at the top of the slope compared to the base of slope, both variants of sowing from top to valley and variant with sowing on level curves direction. Also at

the top of the hill, the water reserve had a lower value in the variant from the top to the valley than variant with sowing on level curves direction. The values of maize water consumption at the base and the top of the hill were similar in both variants regarding on seed direction (table 8).

Table 8

Soil water balance (0-150 cm) in maize sown from top to valley and on level curves direction at the top and base of the hill, Oradea 2013

Position	Interval		Days number	Initial reserve	Rainfall	Total in soil	Final reserve	Total water consumption
	From	To						
Maize sown from top to valley								
Top	1.04.	15.09.	172	4510	2707	7217	3620	3597
Base	1.04.	15.09.	172	4820	2707	7527	3740	3787
Maize sown on the level curves direction								
Top	1.04.	15.09.	172	4670	2707	7377	3680	3697
Base	1.04.	15.09.	172	4730	2707	7437	3710	3727

For 1 m^3 of water used in the top of the hill was obtained 1, 12 kg maize gain in variant sown from the top to the valley. Between water efficiency determined at the base and the top of the hill there is a big difference in variant sown from top to the valley, compared to variant sown on the level curves direction, 53% to 42% (table 9).

Table 9

Influence of the position on the hill on the water use efficiency (WUE) in maize crop sown from top to valley and on level curves direction, Oradea 2013

Position	WUE		Difference
	Kg/m^3	%	%
Maize sown from top to valley			
Top	1.12	100	-
Base	1.70	153	53
Maize sown on the level curves direction			
Top	1.20	100	-
Base	1.71	142	42

In maize sown on the curves level direction at 1 m^3 water used was obtained more mainly yield compared to variant with maize sown from top to valley (table 10).

Table 10

Influence of seed direction on water use efficiency (WUE) in maize crop, Oradea 2013

Seed direction	EVA		Difference
	Kg/m^3	%	%
From top to valley	1.41	100	-
On level curves direction	1.46	104	4

CONCLUSIONS

Maize is one of the crop that assure a bad protection against erosion. Growing maize from top to valley intensified the erosion phenomenon and the research in the leakage control plots located on a land with a slope of 10% at Agricultural Research and Development Station Oradea concerning on studying the influence of sowing direction on the maize yield.

The researches were conducted in 2 different years in terms of climatic conditions.

In 2012, sowing maize from top to valley compared with sowing on level curves direction determined a loss of yield by 2085 kg / ha. However, in variant sowing from top to valley difference of the yield obtained at base and the top of the slope registered is higher than sowing on level curves direction.

In 2013 yield loss registered due sowing the direction from top to valley was 2180 kg / ha, and the difference between yield registered at the base of the slope and the top of slope was higher in maize sowing from top to the valley compared to variant sowing on level curves direction.

Sowing maize on level curves direction provides better efficiency of water used, resulting a higher quantity of primary yield from 1 m^3 of water used.

The research highlights the necessity for maize cultivation on the level curves direction; thereby avoiding major damage caused by erosion and better uses efficiency of rain water.

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