RESEARCH FOR ESTABLISHING THE OPTIMUM SOIL TILLAGE OF THE PRELUVOSOIL FROM ORADEA

Brejea Radu*, Şandor Maria, Domuța Cornel

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea; Romania, e-mail: rbrejea@yahoo.com

Abstract

The paper presents the importance of the soil tillage in maize technology. The researches carried out at the Agricultural Research and Development Station Oradea in the long term trial placed on in 1995.Comparativ with the variant with plough land of 25 cm depth in the variants were the most important soil tillage was with chisel, soil tillage work with roller disk or with plough land of 12 cm depth, the degree of soil compaction has increased; resulting porosity values decreased and the resistance to penetration increased. The highest differences were recorded in the variant worked with a roller disc. At maize crop the best option for basic soil tillage was with autumn plowing executed at a depth of 25 cm. In all other variants studied were losses of yield highly statistically significant in both years studied ; the higher losses (-62% in 2012 and -72% in 2013) were registered in variant worked with roller disc.

Key words: soil tillage, maize, chisel, depth, yield

INTRODUCTION

In the Romanian agriculture the maize together with wheat are the most important field crops. In the maize technology the soil tillage is a very important component. Regarding this problem, the soil type has a big influence in the establishing of the equipment type for realization of the base soil tillage and after that in the establishing of the plough land depth, number of works for preparation of the germination bed (Bogdan et.al., 2003; Canarache, Dumitru, 1995; Rusu 2001, 2005; Șandor et al., 2001, Șandor, 2007; Zăhan, Bandici, 1999). The optimize a base soil tillage determines the decrease of the energy consumption and the most proper vegetation conditions for plants.

The possibilities to reduce the number of tillage in function of the soil type were emphasized, too, because the economical yield gain. The experiment studied different base soil tillage and the purpose was to optimize this component of the maize crop (Berca, 2011; Muntean et al., 2003, 2008, 2011).

MATERIAL AND METHOD

The researches were carried in Oradea during 2013-2014 in the long term trial placed on preluvosoil in 1995.

V_1 = plough land, 25 cm depth; V_2 = plough land, 12 cm depth ; V_3 = work with chisel ; V_4 = work with roller disk

The experiment was placed in randomized band. Number repetition: 4; the surface of the experiment plot was 2000 m^2. Crop rotation used: wheat. Fertilization system: N_{120} kg/ha a.s.; P_{90} kg/ha a.s.

The research field situated at Agricultural Research and Development Station Oradea had the following profile: Ap = 0-24 cm, El = 24-34 cm; BT_1 = 34-54 cm; Bt_2 = 54-78 cm; Bt / c = 78-95 cm, C = 95-145 cm. It is noted that migration of colloidal clay causes the apparition of horizon El with 31.6% colloidal clay and two horizons of colloidal clay accumulation with BT_1 and Bt_2 with 39.8% and 39.3% colloidal clay (Brejea, 2009, 2010, 2014).

Bulk density - 1.41 g/cm3 - characterizes a poorly compacted soil at depth 0-20 cm; on other depths studied the apparent weight highlights a moderately and strongly compacted soil. On watering depth (0-50 cm, 0-75 cm) and on 0-150 cm the soil is strongly compacted (Table 1)..

Table 1.

Physical and hydro physical properties of preluvosoil from research field of Oradea

Depth - cm -	Total aggregates %	Clay 0,002%	BD g/cm3	K mm/h	TP %	Field Capacity		Wilting Point coefficient		Easily available water content	
						%	m^3/ha	%	m^3/ha	%	m^3/ha
0-20	47.5	31.5	1.41	21.0	21	24.2	682	9.2	259	19.2	542
20-40	-	34.1	1.52	10.5	49	23.6	717	9.4	286	18.9	575
40-60	-	39.8	1.58	4.4	48	25.1	768	11.1	351	19.9	630
60-80	-	39.3	1.65	1.0	43	24.4	828	10.8	356	20.4	672
80-100	-	38.8	1.57	0.5	40	23.8	766	12.2	383	20.4	640
100-150	-	37.6	1.54	0.1	39	24.0	1833	14.2	1093	20.6	1586

Field capacity (Fc) is median on the all soil profile and Wilting Point (Wp) has a median value till 80 cm depth and big value below this depth.

Determination of bulk density and penetration resistance after preparation of germination period was done using the methodology of the Research Institute for Pedology, Agrochemistry and Environmental Protection Bucharest. The total porosity (TP) was calculated using the formula (Canarache, 1990):

$$TP = (1-\frac{BD}{D})x100 ;$$

in which: BD- bulk density , g/cm^3

D – specific density, 2.65 g/cm^3

Research results were calculated by variance analysis method. (Domuta, 2006)

RESULTS AND DISCUSSION

Influence of base soil tillage on bulk density

Determinations at maize crop shows that in the conditions of preluvosoil from Oradea, the lowest bulk density was registered by executing 25 cm plowing depth. Determinations after preparation of germination period shows a compacted soil for all other variants, differences comparison with plough land at 25 cm depth were 7,9% in the variant with roller disk , 8 % for plowing at 12 cm depth and 11% at plough with chisel (table 2, Figure 1.).

Table 2.

Influence of base soil tillage on bulk density values, Oradea, 2014

Variant	Bulk density (BD)		Statistically significant
	g/cm^3	%	
1. Plough land 25 cm depth	1,35	100	-
2. Plough land 12 cm depth	1,47	108	**
3. Work with chisel	1,42	105	*
4. Work with roller disk	1,50	111	***

Depth of determination : 0-20 cm LSD 5% 0.3 LSD 1% 0.7 LSD 0.1% 1.2

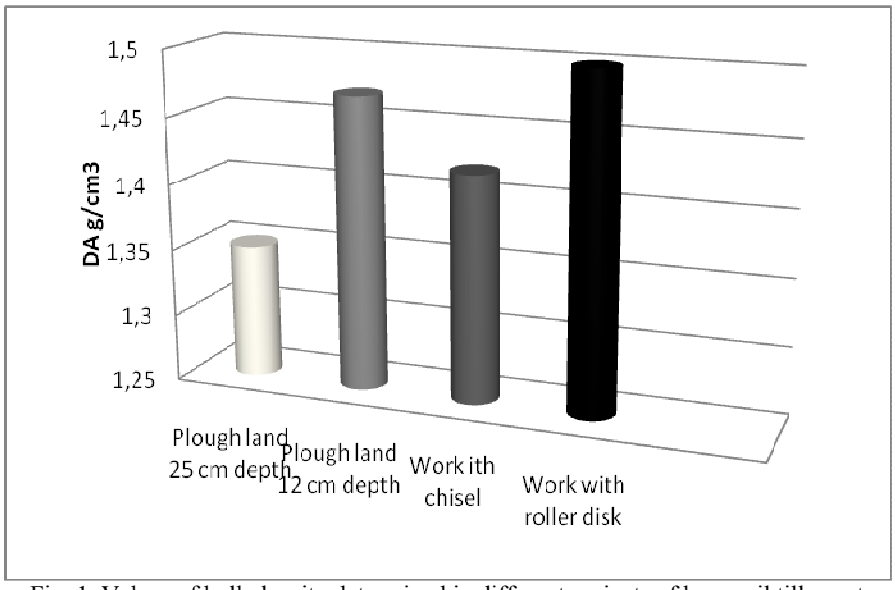

Fig. 1. Values of bulk density determined in different variants of base soil tillage at maize crop, Oradea 2014

Influence of base soil tillage on total porosity

In determination realized after preparation of germinate period of maize crop the higher porosity value of 49% was obtained at variant plough at 25 cm depth, but the order of values is different from the studied variants of wheat; thus, in variant worked with chisel total porosity values were 47%, in the variant with plough at 12 cm depth value was 45% and in variant worked with roller disk was 44%. (table 3, Figure 2.)

Table 3

Influence of base soil tillage on total porosity values (TP), Oradea 2014

Variant	Total porosity (TP)		Statistically significant
	%	%	
1. Plough land 25 cm depth	49	100	control
2. Plough land 12 cm depth	45	91	0
3. Work with chisel	47	95	-
4. Work with roller disk	42	86	00

Depth of determination : 0-20 cm LSD 5% 3 LSD 1% 5 LSD 0.1% 10

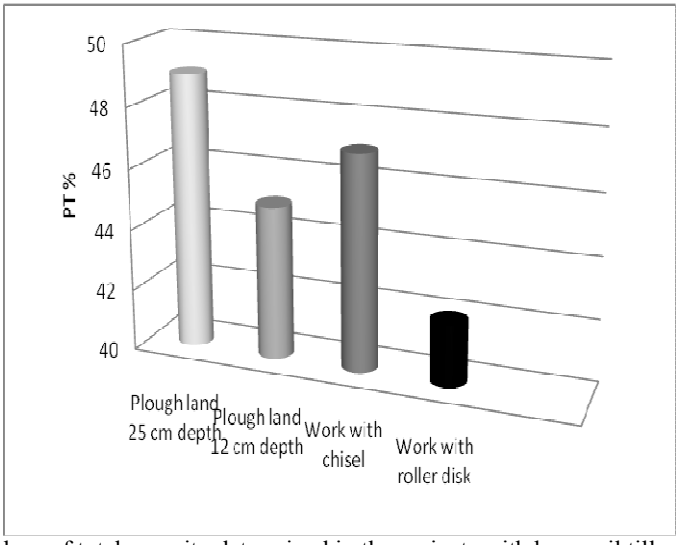

Fig. 2. Values of total porosity determined in the variants with base soil tillage at maize crop, Oradea 2014

Influence of base soil tillage on penetration resistance

Determinations on maize crop shows that at depth of 0-5 cm, the lowest values at penetration resistance were obtained in variant plough at 25 cm depth, in other variants values are equals. In all other depths studied highest values at the penetration resistance were obtained through work with roller disk and the lowest by plowing at 25 cm on 5-10 cm depth and 10-20 cm and through base soil tillage with work with chisel on depths of 20- 30 cm and 30-60 cm (table 4).

Table 4.

Influence of base soil tillage on penetration resistance (Mpa), Oradea 2014

Variant	Depth – cm -				
	0-5	5-10	10-20	20-30	30-60
1. Plough land 25 cm depth	1	1.6	2.1	3.7	5.6
2. Plough land 12 cm depth	1.1	1.7	2.5	3.8	5.6
3. Work with chisel	1.1	1.8	2.5	3.1	5.1
4. Work with roller disk	1.1	1.9	2.8	4.1	5.8

Influence of base soil tillage on maize yield in the conditions of preluvosoil from Oradea, 2013

Using base soil tillage work with roller disk determined higher loss of yield compared to the variant with deep plowing; 5250 kg /ha (-62%) and the other two variants studied yield losses from comparison with variant without plowing were highly statistically significant. (table 5, Fig. 3)

Table 5.

Influence of base soil tillage on maize yield, Oradea 2013

Variant	Yield		Difference		Statistically significant
	Kg/ha	%	Kg/ha	%	
1. Plough land 25 cm depth	8400	100	-	-	Ct
2. Plough land 12 cm depth	6200	74	-2200	-26	000
3. Work with chisel	4200	50	-4200	-50	000
4. Work with roller disk	3150	38	-5250	-62	000
	LSD 5% 180		LSD 1% 370		LSD 0.1% 760

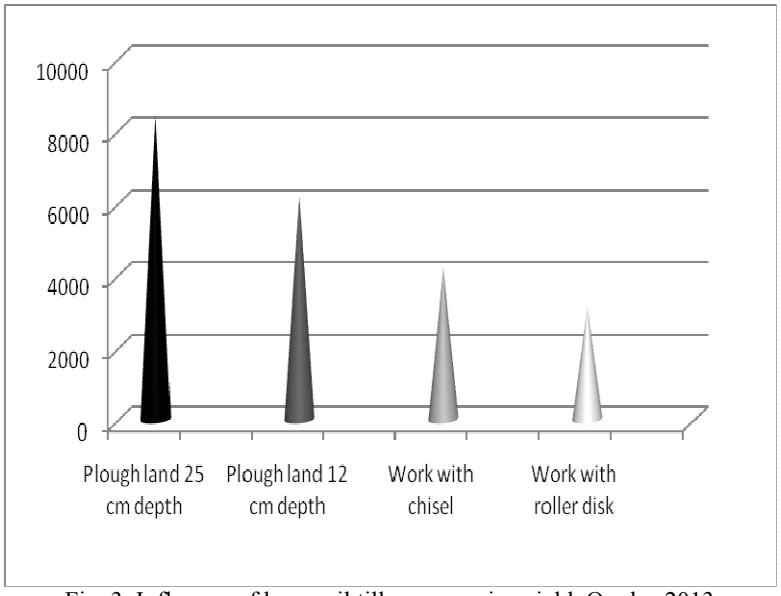

Fig. 3. Influence of base soil tillage on maize yield, Oradea 2013

Influence of base soil tillage on maize yield in the conditions of preluvosoil from Oradea, 2014

In the conditions of the driest year of the years studied yield losses compared to variant plough at 25 cm depth were higher, highly statistically significant in all cases. (Table 6, Fig. 4.)

Table 6.

Influence of base soil tillage on maize yield, Oradea 2014

Variant	Yield		Difference		Statistically significant
	Kg/ha	%	Kg/ha	%	
1. Plough land 25 cm depth	5100	100	-	-	Ct
2. Plough land 12 cm depth	2500	49	-2600	51	000
3. Work with chisel	1990	39	-3110	61	000
4. Work with roller disk	1430	28	-3670	72	000
	LSD 5% 210		LSD 1% 390		LSD 0,1% 670

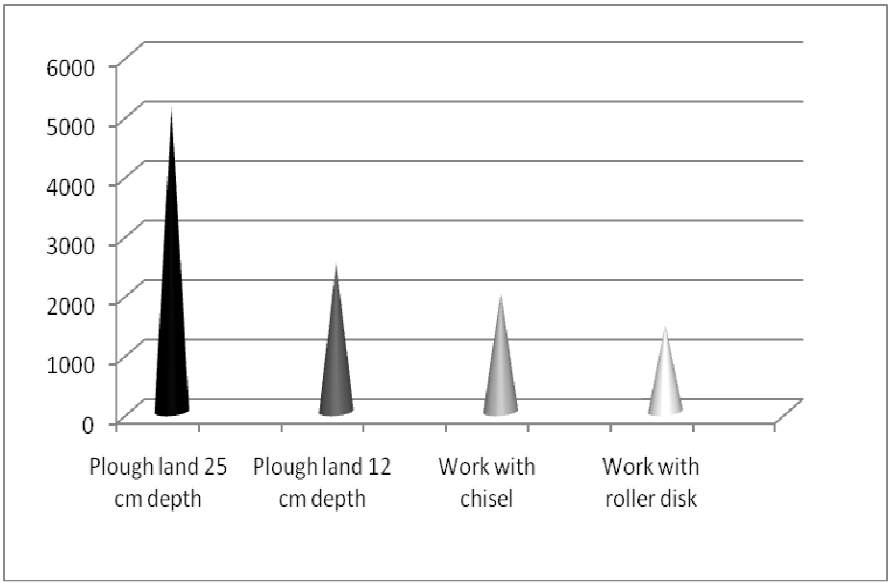

Fig. 4. Influence of base soil tillage on maize yield, Oradea 2014

CONCLUSIONS

The research aimed to establish the possibilities to reduce the basic expenses with work on preluvosoil from Oradea at maize crop. Preluvosoil from Oradea had high content of clay (31.5%) in Ap horizon.

The researches carried out at the Agricultural Research and Development Station Oradea between 2013-2014 in the long term trial placed on in 1995.Comparativ with the variant with plough land of 25 cm depth, in the variants were the most important soil tillage was with chisel, soil tillage work with roller disk or with plough land of 12 cm depth, the degree of soil compaction has increased; resulting porosity values, decreased total and the resistance to penetration increased. The highest differences were recorded in the variant worked with a roller disc.

At maize crop, the best option for basic soil tillage was with autumn plowing executed at a depth of 25 cm, to this depth in all other variants studied were losses of yield highly statistically significant in both years studied ; the higher losses (-62% in 2013 and -72% in 2014) were registered in variant worked with roller disc.

Evolution of soil properties and yield differences highly statistically significant achieved in the years studied indicates that under preluvosoil conditions from Oradea, for maize crop the best option for base soil tillage is autumn plowing executed at a depth of 25 cm.

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