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RESEARCH ON COMPACTION CONTROL OF THE SOILS FROM DIFFERENT AREAS FROM BIHOR COUNTY

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Abstract

The paper is based on the research carried out in Agricultural Research and Development Station Oradea starting with 1967. The research were carried out in there search field from Petid, Buntesti, Cefa, Avram Iancu, Sanmartin, Bihor county. Research on compacted soils in the North-West on Romania, aimed to identify solutionsfor preventing and control the soil compaction, through the application of best and effective measures to increase and maintain soil fertility parameters. Secondarycompaction of the soil has negative effects on physical and microbiological properties ofthe soil, and also on the nutrition conditions for plants. These negative effects can betackled through adequate long-term measures and in a sustainable development context.

Key words: secondary compaction, deep loosening, drainage, melioration crop rotation, organic fertilization.

INTRODUCTION

In the Bihor county, humidity excess is the limiting factor of soil fertility, the most widespread of which is associated frevcent with argillic alteration and soil compaction (the primary one from Bt horizons of argilluvisoil and secondary -layer and that immediately lower layer), acid or salinizate. Thus, in Bihor county is required deep chiselling on 94 thousand hectares, subsoiling works on 176 thousand hectares, acid soil amendment on 165 thousand hectares of the alkali on 9,000 ha, modeling the ridges on 73 thousand hectares, antierosion soil work on 43 thousand hectares, plowing on the drainage direction on 55 thousand hectares, drainage on 168 thousand hectares, leveling operating on 216 thousand hectares, unsystematic ditches and gullies on 213 thousand hectares.

Research in knowledge and improving heavy soils affected by humidity exces began in 1967, by pedoameliorative characterization and organization of field research in the specific conditions of these soils: Depression Holod on the second terrace of Crisul Negru at Petid (1967) in the Crisurilor Piedmont Plain at Sanmartin (1968); Besiusului Depression at Buntesti (1974); High Plain of Crisul Repede from Oradea (1981); in the Cefa (1982) and the low plain of Crisul Negru at Avram Iancu (1983).

MATERIAL AND METHOD

Climatic research field is characterized by annual average temperature of 9.6°C at Buntesti, 10.1°C at Petid, 10.5°C at Oradea and 10.8°C in Cefa and Avram Iancu. In the wetlands in Depresiunea Beiusului and Holod at Buntesti and Petid, annual rainfall exceeded 700 mm, real evapotranspiration is relatively low (575-587 mm) and humidity excess was 136-120 mm (Șandor, 2007).

The main characteristics of soils revealed a number physical, chemical and hydro indices that were limiting their fertility, differentiated on research fields (Table 1).

Table 1.

The main properties of the soil in the research fields

Location and soil type	Horizon	Depth cm	Clay <0,002%	BD g/cm^3	TP %	FC %	K mm/h	pH H2O	Al mobil Soil mg/100g	Humus %	P mobile ppm	K mobile ppm
ORA-DEA	1.	0-24	31.5	1.33	51	23.0	21.0	5.5	3.7	2.32	22.0	83.0
	2.	24-34	31.6	1.38	49	23.2	9.0	5.6	2.3	2.28	23.0	102.0
	3.	34-54	40.0	1.44	47	23.7	6.0	6.2	0.5	1.91	6.0	112.0
	4.	54-78	39.3	1.55	43	24.6	1.0	6.3	0.8	1.93	6.0	118.0
	5.	78-95	39.2	1.62	40	24.6	0.5	6.6	0.3	-	-	-
	6.	95-145	37.6	1.66	39	24.5	0.1	6.5	0.6	-	-	-
SÎN-MAR-TIN	1.	0-22	24.7	1.24	53	23.0	5.5	5.1	1.0	2.80	12.6	59.8
	2.	22-32	23.7	1.52	43	23.0	1.9	5.2	1.4	1.27	11.8	60.0
	3.	32-44	30.0	1.54	43	23.0	1.3	5.2	5.5	1.50	7.8	73.0
	4.	44-90	43.3	1.63	40	24.0	0.2	5.4	2.4	-	7.0	63.9
	5	90-100	40.2	1.65	39	23.0	0.2	5.9	1.2	-	-	-
PETID	1.	0-20	19.8	1.34	50	24.5	6.4	6.1	2.3	1.94	13.9	66.4
	2.	20-39	26.4	1.48	47	24.2	2.6	5.6	2.8	1.34	9.6	66.4
	3.	32-49	39.9	1.45	46	25.4	1.7	5.4	3.4	0.99	4.5	116.2
	4.	49-90	48.7	1.50	44	26.1	0.9	5.7	2.6	0.94	-	-
	5.	90-110	44.7	1.58	41	23.0	0.4	6.3	2.0	0.87	-	-
	1.	0-21	25.7	1.33	51	22.8	6.3	4.8	30.4	2.0	12.2	41.5
BUN-TESTI	2.	21-43	26.7	1.45	46	22.9	2.5	5.1	38.3	1.10	4.0	20.7
	3.	43-55	35.5	1.55	43	23.4	1.1	5.3	57.1	0.40	3.5	24.9
	4.	55-92	36.7	1.56	42	23.4	0.6	5.5	39.3	-	-	-
	5.	92-109	33.7	1.56	42	23.3	0.5	5.6	19.7	-	-	-
CEFA	1.	0-26	40.3	1.35	50	27.7	6.1	7.7	5.1*)	2.60	7.8	74.7
	2.	26-45	41.1	1.46	46	27.0	4.5	8.0	10.8	0.90	3.5	99.6
	3.	45-58	43.1	1.57	42	28.3	1.7	8.6	10.0	1.00	3.0	83.0
	4.	58-81	44.4	1.60	41	27.1	0.6	8.9	12.1	0.90	3.5	99.6
	5.	81-103	41.0	1.57	42	26.0	0.7	9.1	13.7	-	-	-

BD = bulk density; TP= total porosity; FC= field capacity; k= hydraulic conductivity P= phosphorum, K= potassium

Table 2.
Influence of modeling land ridges on eliminating excess water and increasing production on luvisoil albic amfigleic from Petid - Bihor.

Variant	Winter wheat		Maize		Water volume evacuated in cold season	
	q/ha	%	q/ha	%	m^3/ha	% from rainfall
Ploughland	-	100	-	100	-	-
Modeling – 16 m distance	1.5	108	0.9	103	556	26.3
Modeling – 24 m distance	2.5	113	6.8	123	479	23.6
Modeling – 32 m distance	0.2	101	3.9	113	468	22.2

According to data obtained and presented in Table 2, Land modeling in ridge with the width of 24 m of the soil and a length of 200-300 m, proved to be an efficient rainwater humidity excess combat, practicable under current conditions.

RESULTS AND DISCUSSION

Results obtained in the research field from Buntesti

The research was conducted on luvisoils, under a water balance surplus exceeding 130 mm.

The measures investigated for the removal of excess water were different draintypes: ceramic drains 15 and located 25 m away and 0.8 m in depth, drains of stone at 10 and 20 m distance plus perpendicular scarification with the drain lines for soil permeability and facilitating the rain water to drain plus scarification. The soil was amended with 10 t / ha of CaCO3 and annual it was applied $N_{130}P_{90}$ kg /ha in wheat-clover -maize-oil crop rotation, each drainage variant being subdivided for the four crops.

The water volume drained through the drainage system in relation to climatic conditions. During 13 years of research, the results of the discharged water volume, allow ordering variants of removing excess moisture so: ceramic drainage on 10 m distance with the highest annual leakage (2.902 m^3/ ha or 46% precipitation), followed by shaping the ridge (1.428 m3/ha), shaping the ridges plus scarification (1.173 m^3/ha),ceramic drainage 15 m (1.220 m^3/ha), 25 m (1.038 m^3/ ha) and rock drainage at 10 and 20 m (387 respectively 689 m3/ ha). The volumes of water removed in the highest amount, were recorded in the months of December to March. Water leakage through drains recorded the highest frequency in February

(13 years), March and April (12) and January and May (in 10 years of 13) (Colibas, 1990).

Over the research period, the maximum leakage of water in 24 hours was of 39 m3/ha at the drainage system with ceramic tubes at 10 m distance. The variations are preserved and spills within 24 hours maximum sense of variation around the research period. (Șandor, 2007)

The chemical content of the water drained through the drains and gullies, averages on 13 years of researched elements, Highlight the discharge of large amounts of nitrogen that reach up to 26.8 kg N/ha year version with intensity the maximum drainage. The amounts of phosphorus are low (0.1-0.6 kg/ha), also the potassium in the absence of the application of fertilizers potassium. In Table 3 it can be seen that a stone drain with a diameter of 20 meters, evacuates a small amounts of nitrogen, phosphorus, and potassium (Table 3).

Table 3.

Amounts of nitrogen, phosphorus and potassium evacuated annually on drains, Buntesti, Bihor

Variant		N	P	K
		kg/ha/year		
1	Ceramic drain, d=10m+scarification	26.8	0.6	0.6
2	Ceramic drain, d=15m+scarification	16.2	0.3	0.5
3	Ceramic drain, d=25m+scarification	14.5	0.3	0.4
4	Stone drain, d=10m+scarification	7.8	0.2	0.3
5	Stone drain, d=20m+scarification	4.5	0.1	0.2
6	Modeling, 1=20m; L=200m	18.1	0.3	0.8
7	Modeling+scarification	13.2	0.4	1.0

Drainage and scarification are as bulk density decreased to 4-5%, while the air porosity maintained at medium values in all variants.

Penetration resistance decreases by 24-29% between 20-60 cm and hydraulicmconductivity values go from medium to high levels of soil layer at 20-40 cm and at low values to medium values between 40- 60 cm depth.
Research results reveal significant improvements in their application under the influence of $CaCO_3$, scarification, eliminating the water excess, annual fertilization crop rotation. Thus, highly acid soil reaction initial field pass in the acid or weak acid. The ratio of nitrate nitrogen to the ammonia improves very significantly in favor of nitric and has been a significant improvement in the supply of phosphorus and even potassium (without the application of fertilizer with potassium), following the application of annual fertilizer with phosphorus (P_{90} kg/ha) in the soil and creating favorable conditions to mobilization ofphosphorus and potassium in the soil.

The agrophytotechnical measures applied to remove excessive moisture, raising deep prick, shaping the land in ridges with and without scarification, and other, influenced positively the soil yielding. (Colibas, 1983)

The average yield increases that have been achieved over the years of research shows that the measures taken have had a positive effect on productivity. Thus, for winter wheat were obtained increases on the average 13 years old, range from 3.8 to 7.0 q / ha (20-37%) compared to the normal plowing, at maize – between 5.4 to 11.5 q / ha (20-43%), at clover from 1.0-1.4 t/ha hay (14-19%) and at oil flax between 100-160 kg / ha (20-34%) (Table 4).

Tabel 4.

The influence of drainage, modeling and scarification on yield gain in winter wheat, clover and oil flax at Buntesi – Bihor

Variant	**Yield gain**							
	Winter Wheat		**Maize**		**Clover**		**Oil flax**	
	q/ha	**%**	**q/ha**	**%**	**t/ha**	**%**	**Kg/ha**	**%**
Control, ploughland	-	100	-	100	-	100	-	100
Ceramic drain, d=10m+scarification	6.7	135	7.2	127	1.4	119	124	126
Ceramic drain, d=15m+scarification	6.8	136	8.6	132	1.3	118	150	132
Ceramic drain, d=25m+scarification	5.0	126	5.4	120	1.2	117	96	120
Stone drain, d=10m+scarification	7.0	137	9.4	135	1.2	117	162	134
Stone drain, d=20m+scarification	6.4	134	7.8	129	1.4	119	109	123
Modeling, 1=20m; L=200m	3.0	120	8.5	132	1.3	118	16	134
Modelling+scarification	4.4	123	11.5	143	1.0	114	126	127

The biggest production increases were generally made on ceramic drainage at 15 m distance, stone drainage at 10 m.

Results obtained in the research field from Avram Iancu

The soil from research field Avram Iancu are gluey humic soil.

In terms of Avram Iancu, the discharged water volume by drains in excess periods were between 215 and 615 m3 / ha. Soil scarification applied on the drain, influenced the increase by 49-149% of the volumes of water discharged by drains.

The maximum discharged water volume recorded in 24 hours ranged from 16.2 to 61.6 m3 / ha. The mole drainage applied to corrugated drainage tube without filter, increased the drained water volume by 74% and the scarification with 95%. It can be said that the achieved production in maize ranged from 0.9 q / ha with 30 m unfiltered drain and without scarification and 11.7 q / ha (31%) than normal plowing in case of 30m when completed with filter and high permeability soil prick (4.6.). Scarifying increases the production by 15% on drain without filter, 17% on lower filter and 20% on higher filter drainage (Table 6).

The economic efficiency analysis reveals that the high filter drainage at 30 m distance is the most efficient, followed by the low filter drainage and scarification at 30 m, and the drainage without filter at 30 m is less efficient.

The amortization period of the soil improvement by drainage, highlights the fact that in marshy clay, the drainage without scarification of soil permeability is not justified. The effect period of the plastic corrugated tube drainage is estimated at 30 years, or in drainage without scarification this period is longer; so without scarifying drainage, this system is not profitable. (Sandor, 2007)

In terms of energy efficiency, the highest values were registered between 26-35at the drainage with scarification.

Table 5.

The influence of the drainage on maize yield gain and evacuated water in the conditions from Avram Iancu, Bihor

Variant	**Yield gain**		**Evacuated water volume**	
	q/ha	**%**	**m^2/ha**	**%**
Control, ploughland	-	100	-	-
Drain, d=30m	0.9	102	215	100
Drain, d=30m +f scarif	6.5	117	361	168
Drain, d=30m F small	2.4	106	239	100
Drain, d=30m F small+scar	8.9	123	570	249
Drain, d=30m Fî	4.3	111	413	100
Drain, d=30m Fî+scar	11.7	131	615	149

F small = small filter (5-10 cm); Fî = high filter (25-30 cm); sc = scarification

The results achieved in amelioration of the limitative factors of the heavy soil fertility, highlight the need for detailed knowledge of soil conditions and climate.

CONCLUSIONS

The research on compacted soils in the Bihor county, aimed to identify solutions for preventing and control the soil compaction, through the application of best and effective measures to increase and maintain soil fertility parameters. The researches were conducted in several research fields from the Bihor county, as follows: Petid, Buntesti, Cefa , Avram Iancu. The improvement of soil water balance was studied, too; the different types of drains and distance of placement were studied. The drains were placement using the high or short filter in association with scarification.

According to the research, to increase the productivity of the soil from Depresiunea Holod, is needed to design the land ridge width with 24 m and length of 200-300m, which is the most suitable measure to remove excess moisture. The modeling at 24 m distance determined yield gains of 2,5 q/ha in winter wheat and 6,8 q/ha in maize.

Regarding the research field from Buntesti, the agrophytotechnical measures applied to remove excessive moisture, deep ripping raising, fertilizers application in optimal amounts, had a significant influence, resulting in increases of agricultural production. The biggest quantities of nitrogen and potassium evacuated in the average on the year were registered in the variant with ceramic drains at 10 m distance and scarification.

The research from Cefa and Avram Iancu in order to remove excessive moisture, to permeabilize the soil by draining, scarification, gave very good results in terms of agricultural productivity. Both in Cefa and Avram Iancu the biggest yield gain in winter wheat and maize, and the biggest water quantity evacuated were registered in the variant with drains placed at 30 m distance, high filter and scarification.

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