

RESEARCH REGARDING THE BEHAVIOR IN EXPLOITATION OF THE INAND DRAINAGE SYSTEM FROM CRISURILOR PLAIN

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Abstract

The paper is based on the research carried out during 1991-1998 in the drainage system Inand from Crisurilor Plain and emphasized the importance of the drainage works associated with scarifying and lime for the soil with water lagging from Crisurilor Plain and Western Romania. The paper presents the influence of the rainfall on the level of water in the drainage canals, the evolution of the ground water level, ground water mineralization pilot drainage field from Cefa.

Keywords: drainage, soil, water.

INTRODUCTION

There were 5530 thousand hectares with water logging in Romania and on 3200 thousand hectares the surface-drainage and drainage works were made; 34.1 % from the surfaces with surface-drainage and drainage works are situated in the Western Plain of Romania. The paper regarded the study of the behaviour in exploitation of the 3285 hectares with surface-drainage and drainage works of the Inand system from Crișurilor Plain.

MATERIAL AND METHOD

The researches were carried out during 1991-1998 and wanted to find out the technical and economical solutions concerning a better exploitations of the land reclamation for the melioration of the yield capacity of the agricultural land, for obtaining big yield, with better quality and profitable, the protection of the new created agricultural ecosystem against the pollution factors.

The paper have the fallowing objectives: the knowledge of the stage of the researches regarding to exploitation of the works for surface-drainage and drainage; the characterization of the natural conditions of the research zone; study regarding the causes and the sources of the water logging and regarding the size of this phenomenon; analysis concerning the behavior in exploitation of the surface drainage and drainage system Inand; the influence of the way of the exploitation of the surface drainage and drainage works on hydraulic and construction parameters of the canals and drains; the influence of the way of exploitation of the surface drainage and drainage

works on soils; the influence of the way of exploitation of the works for surface drainage and drainage on chemical properties of the soils; the evolution of the soil, of the water ground and of the drainage water after 15 years of functioning of the surface- drainage and drainage works; the influence of the works on agricultural yields; economical efficiency and energy efficiency of the works for surface – drainage and drainage; elaboration of the new measures and technologies for exploitation of the surface – drainage and drainage system Inand.

For realization of these objectives, the researches on the all area of the surface-drainage and drainage system Inand and in research field Cefa were made. Numerous observations regarding the cleaning and maintenance of the canals, of the drains, laboratory determinations and analysis were made and many calculations were made too.

Inand area is a plain with numerous micro depressions and in the period with surplus of the rainfall the water logging is present. The area belongs to quaternary from geological point of view. Water ground is found in sandy area and his character is permanent one. The depth of the ground water is between 1 – 3 m in Inand, 0,5 – 4 m in Cefa and 3 - 4,5 m, the depth of the ground water is depended of the rainfall regime. The chemical analysis of the ground waters indicate a mineralization from moderate to very high, the cause is the presence of the salinization soils.

In the surface – drainage and drainage system studied there were a complex of soils including humic gley soils, alluvial soils, cambic chernozems with different degree o gleyzation and pseudogleyization, salinization soils, etc. In the depressions area come out under the influence of the surface drainage works, the processes of soil genesis are carried out in anaerobe regime and the processes of hydromorphysm are presented.

The Inand area is characterized by temperate climate, moderate wet, with average yearly temperature of 10,7° C and yearly rainfall of 560,6 mm.

Climate indexes (de Martonne aridity index, Donciu index) characterized the cold season from „moderate wet” to „excess wet” and the warm season moderat dry – very dry. May and June are characterized moderate wet.

Climate balance emphasizes in the area a more quantity of the rainfall than evapotranspiration in the six month of the year; in this conditions there were periods with surplus of water between October and April and even in June.

The presences of the water logging in this area are due by the regimes of the rainfall and water logging and low natural drainage, both external (due by the small slope of the land) and internal (due by the presence in the soil of the horizons with many clay, almost waterproof.

RESULTS OBTAINED IN THE INAND DRAINING SYSTEM

The levels of the water in the surface drainage canals are in direct correlations with rainfall registered. The yearly variation of the water level in the canals had a maximum values in the cold season and a minimum values in the warm season. Specifically surface-drainage discharge had different values in the month of the years variation interval was between 0,015 l/s.ha in October and 0,700 l/s.ha in June. The yearly averages were of 0,284 l/s.ha in 1994/1995, of 0,201 l/s.ha in 1995/1996, and 0,190 l/s.ha in 1996/1997.

Hydrogeological determinations and observations from the surface drainage Inand emphasized the influence of the canals network on the evolution of the ground water level. There is a tendency of decrease of the ground water level of 0,58 m – 0,78 m due by the drainage effect of the canals. The decrease of the ground water level determined a decrease of the surfaces with ground water on the depth till 0,50 m (about 20%) on the depths 0,50-1,0 m (about 10%) and on the depths 1,0-1,5 m (3%).

The surface drainage works influenced the mineralization of the ground water. The decrease of the ground water level due by elimination of the water logging determined the decrease of the mineralization degree from moderate – strong (0,20 – 6,10 g/l) to moderate mineralization (0,50-0,80 g/l)

In 15 years of functioning the surface drainage and drainage system modified the canals, especially the section for of the water floo. The measurements emphasized a degree of silting between 5% and 30% (smaller in the canals of superior order). The weight of the weeds was of 6 and 15 kilograms green weight on 1 linear meter of canals In the areas with salinization soils, the canals section is larger and the taluses became 1/2 - 1/3 in comparison with 1/1,5 – 1/1,75 at the execution. At the bridge, a silting of 10 – 25% and a settling of 15 – 30 cm of the foundation was registered.

The yield realized in the research field for surface drainage and drainage Inand in the 15 year of the functioning increased to 1100 Kg / ha in wheat crop and to 1450 kg / ha in maize crop.

RESULTS OBTAINED IN THE PILOT FIELD FOR DRAINAGE CEFA

The years of period 1994 – 1997 are characterized median and excessive droughty and good conditions for seeding in spring.

The soil from the drainage field is a humic gley soil one with different degree of salinization. The subtypes of the soil from this field are:

- typical humic gley;
- insufficiently salinization and moderate alkalization;
- insufficiently alkalization.

The chemical properties of the humic gley soil emphasized the need of the correction of the salinization using the gypsum and the need of the use of the chemical fertilizer for better supply with main nourishing elements.

In the conditions of the humic gley soil moderate salinization the application on the prism filter of the phosphogypsum dose are need for substitution the sodium from colloidal complex; this work realized the improvement of the soil properties.

The humic gley soil from research field Cefa is characterized by high content of the colloid clay, with values of 40 – 44 %. The bulk density values $1,35 \text{ g/cm}^3$ – $1,60 \text{ g/cm}^3$ indicate a settled soil; the values of penetration, resistance indicate a settled soil too. Saturated hydraulic conductivity have the big values on the surface, 6,1 mm/h, and median – small on the other depths.

The quantity of the nitrogen evacuated with the drainage water in the studied period is of 12,33 Kg/ha to 3,44 Kg/ha. The quantity of the nitrogen evacuated is in direct link with the rainfall volume registered in the studied period.

The variation of the water ground level in the studied drilling was very different on the months and years. In the cold period of the year, the level of the ground water is near the soil surface, at the 6 cm depth in March and May. In the warm the ground water is situated at the drains depth and bellow this depth, at 169 cm.

The humic gley soil with ground water with B – Na salinization of value under 1 g/l and situated at < 2 m depth don't produce the processes of soil secondary salinization. The high value of report between Na^+ and bivalent cation determined salinization process under 80 – 100 cm depth in this type of soil. The irrational exploitation of the land determines the appearance of the soil degradation by secondary salinization.

The analysis of the main anions and cations of the soil emphasized a strong correlation between chemical properties of the water ground and the soil in the depth where the water ground is situated. In the water evacuated by drains the predominant type of salinization is B – Na, B – Ca, and B – Mg.

After 15 years of the drainage effect and of the pedomelioration works, the chemical and physical properties of the soil were influenced in positive direction.

The drainage works in association with the scarifying determined the increase of the saturated hydraulic conductivity. Air porosity was increased,

too; These conditions favored the oxidation processes in the soil and the quantities of the $N - NO_3$ were doubled in comparison with the quantities of the $N - NH_4$. Bulk density values were median one on 0 – 20 cm depths ($1.27 - 1.33 \text{ g/cm}^3$), big and very big on the next depth ($1.35 - 1.59 \text{ g/cm}^3$). The values of the degree of moistening were between 19.1 and 34.9 % on the first depth; below these depths, the values of the degree moistening were bigger than field capacity.

The total porosity is characterized by very small, small and median value and the soil are moderate settled. Air porosity values are median, at the superior depth, small and very small below these depths. The values of the penetration resistance are median and big (22.8 and 53.2 Kg/cm^2) and increase on the soil profile. On the ploughing land, the values of the saturated hydraulic conductivity are big and very big (55.6 mm/h) becoming small and very small on 60 – 80 cm depth (0.3 mm/h).

The values of the index for aeration deficit emphasized moderate, good and very good conditions. The values of this index were influenced by the distance between the drains and by the loosening depth. In the variant with the drainage of 15 m distance, high filter and scarifying, the aeration increased with 200 – 60 % in comparison with undrainaged witness.

The values of soil structure aggregates of the humic gley soil from research field Cefa cover all the classes of the characterization. These values decrease on the soil depth. The dispersion increase on the soil profile and the difference between the depth are very small. The values of the dispersion decreased to 20 % in comparison with the witness.

The study of the sediments from the drains for this research field was realized in this paper first time after the execution of the drainage work. The biggest values were obtained in the variant with 30 m drainage distance, F.m. and Cr, 625 g/m drain. The sediments from drain have a big percentage of colloid clay, 63 %, the $CaCO_3$ content is median 4.17 % and small 0.35%; the structure aggregates have very big values (49 %), big values (28 %) and small values (15%).

The biggest energy efficiency was obtained in the same variants with the biggest economical efficiency. The energy report in the variant with unsystematic drainage was of 66.6 and in the variant with the drainage distance this report had the value of 30.3.

In the condition of the Western Plain of Romania the control of the water logging involved to project the drainage, in association with the organization of the territory and with the works for the improvement of the soil permeability; the consequence is the improve of the chemical, physical and biological properties of the soil.

Knowing the level of the ground water, the chemical contents of the water and soil, pedological studies regarding the evolution of the chemical,

physical and biological properties of the soil are need; the recommendation of the technologies for maintenance and improvement of the soil fertility are need too.

There were a lot of conditions for water logging on the humic gley soil, moderate salinization from the Crișurilor Plain. In these condition, to designing and the execution of the new drainage system in the future are need, too. The drainage works will be associated with pedoamelioration work (liming, scarifying) realizing the improvement of the chemical, physical and biological properties of the soil, the increase of the agricultural yields, in conditions of high profitableness.

CONCLUSION

The paper is based on the research carried out during 1991-1998 in the drainage system Inand from Crișurilor Plain and emphasized the importance of the drainage works associated with scarifying and lime for the soil with water lagging from Crișurilor Plain and Western Romania.

The paper presents the influence of the rainfall on the level of water in the drainage canals, the evolution of the ground water level, ground water mineralization pilot drainage field from Cefa.

The different distance of the drains were studied and melioration works (scaryfing, gypsum) were studied on the humic gley soil from Cefa.

Maximum specifically discharge in the first years of the functioning were between 0,42 l/s.ha and 0,910 l/s.ha; the biggest values was registered in the variant with unsystematically drains and scarifying.

Specifically discharge of the drainage for assurance of 1, 3, 5, 10 and 50% have the smallest values in the variants 0,69 - 2,84 in the variant with unsystematically drains.

The average of the drainage discharge for the period 1994-1998 is the 0,01 l/s.ha in October and 0,80 l/s.ha in June.

The biggest volumes of the evacuated water on the drains in the first 7th years of the functioning were registered in the variant with the distance of 30 m between lines of drains, high filter and scarifying; this variant evacuated 22,3% from rainfall. The smallest values evacuated were registered in the variant with drains placed at the distance of 45 m; this variant evacuated 12,6% from the rainfall.

The water volumes evacuated in case of the maximum rainfall registered the biggest values in the variant with 35 m distance between drains, 280 m³/ha and the smallest values in the variant with 30 m distance between drains and small filter, 6,40 m³/ha.

The quantity of the salts evacuated by drainage water in the research period is of 13.28 kg/ha in the variant with 30 m Fî + Sc. and 4.71 kg / ha in

the variant with 30 m distance between the drains. The quantity of the salts evacuated was determined by the water volumes evacuated on the drains, water mineralization the phosphogyps applied on the prism filter and by the type of the soil from the variant.

The determinations of the sediments in the collecting secondary canals from research field Cefa emphasized the values of 29 cm and 47 cm.

The species of the weed structure from the canals are specifically for these type of soils. The biggest quantity of the vegetation was determined in the variant with unsystematically drains, 29.3 kg/ml of canals and the smallest quantity was registered in the variant with drainage distance of 15 m, high filter and scarifying, 14,4 kg/ml

In the wheat crop the biggest yield gain were obtained in the variant with the drainage distance of 30 m, high filter and scarifying, of 19 % in comparison with witness without drainage and pedomelioration works.

In the sunflower crop were obtained the yield gain of 33 % in the variant with drainage of 30 m distance, short filter + mole drainage in comparison with the witness.

The best economical efficiency was obtained in the variant with unsystematic drainage + scarifying; the profitableness rate in this variant was of 3.68; this variant is followed by the variant with 30 m distance between drains, high filter + scarifying with a profitableness rate of 2.20; the variant with the smallest profitableness rate was the variant without melioration works, with a rate of 0.41.

REFERENCES

1. Bîlteanu Gh. Bîrnaure V., 1979, Fitotehnie. Editura CERES, București.
2. Borza Ioana Maria, Alina Șt. Stanciu, 2010, Fitotehnie, Editura Universității Oradea
3. Brejea R., 2009, Tehnologii de protecție sau refacere a solurilor. Editura Universității din Oradea.
4. Brejea R., 2010, Știința solului. Editura Universității din Oradea
5. Canarache A., 1990, Fizica solurilor agricole, Editura CERES, București
6. Colibaș Maria, 1974, Cercetări privind influența chimismului apelor freatice din zona de câmpie Mureș – Crișul Repede, asupra solului și plantelor agricole. Teză de doctorat A.S.A.S. București, 244 pagini.
7. Colibaș Maria, Colibaș I., 1981, Raionarea nivelului și chimismului apelor freatice din Câmpia de vest a țării, zona Mureș – Crișul Repede. Analele I.C.P.A. vol. XLV.
8. Domuța C. și colab., 2003, Cercetări pentru cuantificarea corelațiilor din sistemul sol – apă – plantă la principalele culturi din Câmpia Crișurilor. Analele Institutului de Cercetare – Dezvoltare Agricolă Fundulea, 2003.
9. Domuța C. și colab., 2005, Moisture stres on the irrigation depth and their influence on the yield in main crops from Crișurilor Plain during 1976-2003, Natural Resources And Sustainable Agriculture, International Scientific Sesion, Oradea-Debreceen.
10. Domuța C., Brejea R., 2010, Monitoringul mediului. Editura Universității din Oradea.
11. Domuța C. și colab. 2000, Irigarea culturilor, Ed. Universității din Oradea

12. Domuța C., 2003, Oportunitatea irigațiilor în Câmpia Crișurilor. Editura Universității din Oradea.
13. Domuța C., 2005, Practicum de irigarea culturilor și agrotehnică. Ed. Universității din Oradea.
14. Domuța C., coord., 2009, Irigațiile în Câmpia Crișurilor. Ed. Universității din Oradea.
15. Domuța C., 2009, Irigarea culturilor. Ed. Universității din Oradea.
16. Florea N. și colab., 1987, Metodologia elaborării studiilor pedologice, ICPA. Redacția de propagandă tehnică agricolă, București.
17. Grumeza N. și colab., 1987, Folosirea rațională a apei în exploatarea amenajărilor de irigații, Red. de prop. agricolă București.
18. Oneț Aurelia, 2012, Environmental Management, University of Oradea Publishing House.
19. Oneț Cristian, Oneț Aurelia, 2011, Dynamics of water usage in food industry according to technological process, Anals of University of Oradea, Fascicula de Protecția Mediului.
20. Șandor Maria, 2004, The influence of the king explotation on the vegetation from canals and of the drainage paramethers from the research field Cefa, Bihor. University of Oradea, Faculty of Enviromment Protection- University of Debrecen. Natural Ressources and Sustainable Development, 23-24 aprilie pag 46.
21. Șandor Maria, și colab., 2004, Physical and chemical properties of the sediments from drains from research field Cefa, Bihor County - Proceeding of University of Debrecen, , pag.45-46.
22. Șandor Maria, 2007, Combaterea excesului de umiditate în Câmpia Crișurilor. Editura Universității din Oradea.
23. Șandor Maria, 2007, Ameliorarea solurilor cu exces de umiditate din Câmpia Crișurilor. Editura Universității din Oradea.