"ION IONESCU DE LA BRAD" UNIVERSITY OF AGRICULTURAL SCIENCES AND VETERINARY MEDICINE OF IAŞI
FACULTY OF AGRICULTURE

FIELD OF DOCTORATE: AGRONOMY
SPECIALIZATION: EXPLOITATION OF LAND IMPROVEMENT SYSTEMS AND CROP IRRIGATION

DOCTORAL THESIS

"CONTRIBUTION ON THE STUDY OF THE BEHAVIOUR IN EXPLOITATION OF DRYING-DRAINAGE SYSTEMS CARRIED OUT IN THE MEADOW OF THE MOLDOVA RIVER, PĂLTINOASA-DRĂGUŞENI SECTOR"

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IAŞI-2008

ABSTRACT

Agriculture was, is and will always be the economic branch that supplies food-the essence of human existence, with deep political, economic and social implications.

The highest valorisation of the production potential for each field area and its continuous increase in its fertility require the knowledge of the limitative factors of farming production, according to which they establish the measures meant for obtaining the desired results, corresponding to the agricultural material base, to the technical-scientific level and to the natural conditions from each zone of the country.

Taking into account the varied relief from Romania and the complexity of soil layers, great field areas are affected by one or more limitative factors, such as moisture excess or deficit, erosion, acidity, etc.

Florea M. and Munteanu I. (1972) assess that of the total area of Romania, 8.620.000 ha of arable field have different degree-moisture excess, according to water source, relief and soil conditions, etc.

Balancing the water and air regime from soil and solving the problems of secondary salinization and stagnation by drying-drainage projects represent a matter of protection of one of the most important environment factors, which is soil. In order to improve moisture excess-affected soils, until 1990 drying-drainage works were carried out in Romania on 3.2 million ha, of which 0.2 million ha worked with underground drainage. After achieving water improvement projects, a special importance had to be paid to their exploitation and behaviour in time and to the evolution of soil physical, chemical and biological characteristics. Therefore, in our PhD Thesis, entitled "**CONTRIBUTIONS ON THE STUDY OF BEHAVIOUR IN EXPLOITATION OF DRYING-DRAINAGE SYSTEMS, CARRIED OUT IN THE MOLDOVA RIVER MEADOW, PĂLTINOASA – DRĂGUŞENI SECTOR",** we have analysed the main aspects of carrying out in time these water improvement projects in a significant zone for moisture excess, having also in view the new conditions, which appeared after the passage to a new form of projected land ownership.

For removing moisture excess from the meadow and terraces of the Moldova River, in the Păltinoasa-Drăguşeni sector, they arranged during 1978-1980, three drying-drainage systems (Rotopăneşti-Rădăşeni-Fântâna Mare, Drăgoieşti-Berchişeşti and Bogdăneşti-Baia) and the irrigation-drying system Băişeşti-Dumbrava, summing up a dried area of 8761 ha, of which 2559 ha with underground drainage works.

Investigations and observations were conducted for 6 years, during 2002-2007, in the Baia pilot experimental field of agricultural drainages and in the observation fields Sasca 1 and

Sasca 2, situated in the Rotopăneşti-Rădăşeni-Fântâna Mare drying-drainage system. We have also carried out observations on channels and drains network within the four water improvement systems, arranged in the Păltinoasa-Drăguşeni sector.

The main objectives of this PhD Thesis were the followings:

- pointing out the modification of geometrical and hydraulic parameters of the drying network, after 27 years of working;

- influence of natural and human factors on the characteristics and integrity of the drying network;

- behaviour in exploitation of hydrotechnical constructions and devices from the channel and drainage network;

- efficiency of removing moisture excess by different constructive drainage variants;

- influence of maintenance works on functioning of drying-drainage network;

- efficiency of ridge strip modelling on fastening the removal of moisture excess, under conditions of the land passage towards a new form of ownership;

- influence of drying-drainage projects on the structure of usage categories for lands, crops and obtained yields.

For estimating the modification of geometrical elements and constructive parameters of the drying channels, we have done measurements of geometric levelling; on its base, transversal and longitudinal profiles were drawn, which were compared to those initially designed and made.

For determining the water content from soil on constructive drainage variants, soil samples were taken from the Baia experimental field, every 10 cm, until the depth of 1 m. The checking points were placed on cut-off trench, 2 m to the drain line and at the half distance between the drain lines. We have also measured the water discharged after rainfalls.

In order to clog up in time the pipes of suction drains, we have digged until we reached the drain pipes and assessed the thicknesses of deposits inside the pipes.

The influence of land modelling in ridge strips on the acceleration of moisture excess removal was determined on soil sampled at distances of 3.0 m or 3.5 m and on rills, ridges and cut-off trench.

After 27 years since the execution, we found out that the drying-drainage projects did not work at the designed capacity, because of the degradation in time and of the improper exploitation of the drying-drainage area. As concerns the channel networks from the drying-drainage systems, Păltinoasa-Drăguşeni sector, we found out that in 27 year-work and exploitation, erosion of banks and clogging up of channel bed were produced, the mean rate of

clogging up of about 2-4 cm/year being estimated, which resulted in diminishing the discharge opening of channels at a rate of 30-35 %.

On the fields used as grasslands, where the grass-covered area of canal banks is highly degraded, while on some sections it is absent, because of the unreasonable grazing and uncontrolled animal passages during moisture excess periods, the mean rate of clogging up is of 4-5 cm/year.

Within the arable areas, the canals have slopes well covered with grasses, thus diminishing the slope erosion, but at the same time favouring hygrophilous vegetation and shrubs and producing clogging up.

The sector collecting canals from grazed areas were clogged up at a rate of 80-90 %, resulting in total or partial covering of the exhaust openings from suction drains and laying out of works the drainage network. As a result, the moisture excess was found again, therefore, canal section clogging up and recovering being required. Taking into account the diminution in the canal section by a mean annual rate comprised between 1.11 and 3.33 % and the fact that in the last 17 years, the annual rate of section reduction is much more pronounced, because of the improper exploitation of areas arranged with drying-drainage works, we estimate that in the next 10 years, the higher part of inferior canals will be laid out of work and in the next 20 years, the superior canals.

The hydrotechnical constructions on the canals network are deteriorated at a rate of 60-80 %, because of the lack of maintenance works and of spoiling, especially after 1990, by subtracting flagstones from slope consolidation around catwalks, from pool connection, canal confluence, checking sections and flow measurements. Most of catwalks have clogged up sections at a higher than 60 %, which requires unsilted conditions and consolidation, for avoiding water flooding during abundant rainfall periods and in spring at snow melting. As concerns the drain network, in the working period of 27 years, the suction drain clogging up was produced on the average of 1-1.5 cm, the pipe section being diminished by 5-7 % and the discharge capacity being maintained at normal values.

The observations carried out in the Baia pilot experimental field have shown that an efficient discharge of the moisture excess was done under conditions of using gravel as filtering material at 15-20 cm thick layer and of flax stems associated with gravel. The values of discharged flows show a slight increase in drain lines with smaller placing depths and distances. The main deficiency in the drain network functioning is the obstruction of the exhaust openings in suction drains, which is found especially in sector collecting channels and in the regions where the drained areas are used as grasslands. The obstruction of exhaust openings in closed suction drains, on the arable lands and grasslands, involves the laying out of works of the entire drain

network, favouring the reappearance of moisture excess on these areas. The landowners carrying out sporadic and isolated maintenance works of drying channels on lengths corresponding to the width of plots, the effect was not successful, because thresholds were formed, resulting in water stagnation in channels and in greater moisture excess. As a result, applying maintenance works across the length of the channel and their execution from downstream to upstream were required.

The land modelling in ridge strips, in concordance with the drain network, favours the removal of water excess, due to directing of the surface leakages towards suction drain lines, achieving a better water interception and removal, in the first hours and days of moisture excess. Because at the reconstitution of the ownership right, they had not in view the routes of drain lines, the individual plots were placed perpendicularly to the suction drains, under an acute angle or parallel to them. Thus, by modeling the land in ridge strips, as an effect of soil tillage on individual plots, unevenness has resulted in removing water excess on the areas arranged with drying-drainage works, because of the change in suction drain depth and of the different positioning of rills towards the drain lines.

Within the plots placed parallel to suction drain lines, the drains below the rills have a better interception and discharge of water excess, which is removed in a shorter time, because of drains lower depth, of the greater opportunity to intercept the less permeable layers by soil tillage and to direct the surface runoff towards the drain line. The functional output of suction drains situated below the ridges is more reduced, because of increasing the placing depth and of directing the surface runoff laterally to the middle distance between drains.

The frequency deviation of water content on dried-drained areas and modeled in ridge strips, as a result of soil till on individual plots, is maximum at 3-5 days since the registration of rainfalls, reaching values of 6-10 percent units, while after 10 days, it diminishes at 1-2 percent units.

In case of plots perpendicular to suction drain lines, a removal of water excess relatively close to that of drains below rills was achieved. As concerns the evenness of water excess removal on the dried-drained area, they pointed out the drains below the rills, within the plots parallel to suction drains and suction drains perpendicular to individual plots.

Due to the low probability of rill formation above the suction drain lines, as a result of individual soil tillage on fields where plots are perpendicular to the suction drains, the best moisture excess removal is done.

The arrangement of drying-drainage systems in the Păltinoasa-Drăguşeni sector has resulted in removing the moisture excess from meadow and terraces of the Moldova River, which allowed the usage in this region as arable field of another 1850 ha, on the account of grasslands and hayfields. Improving the soil physical, chemical and biological characteristics has

determined the increase in the cultivated plants assortment and obtaining great and constant yields.

By the passage to a new form of ownership, once with the application of Law 18/1991, the arable area has diminished, both by the passage of compact areas to the usage category of grassland, as well as by the isolated passage of individual plots to categories grasslands and hayfields, because of water stagnation in the zone of rills, especially in spring, for a longer period of time. The arable area was highly divided by individual soil tillage, resulting in time a modelling in ridge strips with widths, level differences and transversal slopes varying according to the width of land plots, the way of usage and the used equipments. This land division results in diminishing the crop yield by 20-50 %, according to plot width, because of the losses produced on the boundary line and in the zone of rills.

The need of assuring a high living standard by maintaining the productive potential of soil requires urgent measures at local level, which lead to the reasonable use of lands and of the drying-drainage network.