Maximizing the Positive Impacts of Irrigation and Its Influence on the Settlement of Soil Particles

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Abstract. Researches presented, are the subject of study on the evolution of soil quality indicators of Romanian Plain, where mainly is chernozem soil type, as a consequence of irrigation. To achieve the objectives we have studied some physical indicators of soil (bulk density and total porosity) in the territory concerned, the interpretation of analytical results been performed according to the proper methodology, after taking soil samplings from pedogenetic horizons. Through an analysis of the evolution of chernozem’s soil compaction, due to irrigation’s application, it highlights different soil compaction status correlated with the physical condition of the soil. If irrigated soil, in maize crop, loosening is moderate in the layer 0-10 cm, with values of 1.20 g/cm³, after applying every year of irrigation, it indicates values ranging in a fairly widely, from small (moderately loose soil, with bulk density of 1.23 g/cm³), the medium (soil poorly compacted, bulk density was 1.45 g/cm³). Total porosity values are down slightly throughout the soil profile under the influence of irrigation, values are in the range middle - very high. After applying irrigation are observed physical changes, that induced changes in the balances resulting from damage to structure and structure to appear grainy dust structure and consequently the tendency of poor compaction and physical change of the soil.

Keywords: irrigation, soil, total porosity, bulk density, indices, fertility.

INTRODUCTION

Correct revaluation of soil in production process, by fertilization, irrigation and suitable soil tillage, determine potential fertility preservation and growth. In this context we can say that irrigation under study, is an anthropogenic ecological factor with implications for the development of soil quality indices and hence the changes they induce.

These researches are based on the investigation and evaluation of physical properties such as bulk density and total porosity, made at different times, which may serve as indicators of soil quality, demonstrating the usefulness of the findings on the behavior and soil compaction (Florea and Ignat, 2007).

Research on the influence of irrigation on different soil types were been made in our country and abroad by various researchers, including Douglas et al. (1998), Filipciuc (1999), Wang et al., (2003), Portela and Pires (1999), Shopski and Doneva (1999), in order to understand the processes that may occur under the impact of this technology.

It is estimated that prolonged application of irrigation technology can cause significant changes in soil nutrient regime elements, reaching changes in the clay mineralogy (Dumitru et al., 1999). Following the studies on soil type argic chernozem, researchers have observed that under the influence of irrigation by microjets, granulometric composition...
changes, meaning that colloidal clay shows a slight increase in depth, content of silt rising from 31.5 % in non-irrigated to 32.2% in irrigated one and bulk density has a growing trend.

Following research made by Ungureanu et al. (2000) on a chernozem with clay loam texture, found that long-term irrigation contributes to the redistribution of particle size distributions in the profile and to deterioration of water stability of soil aggregates.

The correct application of irrigation, with moderate intensity and high (good) water quality, can have indirect beneficial effects on physical condition, by stimulating the natural processes of wetting and drying and it can be considered the main way to obtain increased production in perimeter soils generally occupied high potential fertility (Burcea 2009).

MATERIAL AND METHOD

The research was conducted on a chernozem soil type, land equipped with irrigation systems, that are located on both sides of the national road (NR 6) Bucharest-Alexandria, and the territory is covered by the irrigation system mainline Terrace Vişoara.

Research has as a starting point system analog represented by conducting soil profiles on both non-irrigated plots and irrigated at least 10 years ones, in order to allow observation by comparison of the soil physical changes, due to the application of the technology.

The methods used to determine the soil physical properties (bulk density and total porosity) were made in the laboratories of the Teleorman Soil Survey and Soil Testing Office, according to the Methodology development of soil studies – Part III, for an average sample on 3 ha, evenly the area under investigation.

Were studied, by comparing, two irrigated crops from winter wheat-maize-sunflower rotation, namely culture - winter wheat, maize and that the same culture that is on the same soil type but under irrigation. During the experimental period 2009-2011, the winter wheat irrigation was applied rule of 500 m$^3$/ha in May, and the maize irrigation was applied a rule of 1,300 m$^3$/ha of water, administered in three stages, last one on the end of June.

RESULTS AND DISCUSSIONS

The influence of irrigation on bulk density (DA) of a argic chernozem

The physical property of the soil, which has crucial role in modifying other characteristics is bulk density (BD), along with the penetration resistance (PR), define the state of soil compaction (Dumitru et al., 1999).

Through an analysis of the evolution of the soil compaction for an argic chernozem, depending on the application of irrigation, confirm the status of different soil’s compaction state.

Non-irrigated soil has a moderate loosening status on depth 0-10 cm, with low bulk density (1.21 g/cm$^3$), on maize, which is preserved in the same range for winter wheat (1.24 g/cm$^3$). In the next 20 cm, it’s observed a slight soil compaction, especially for winter wheat, which is passed to the class of values ”poor compacted” (having a bulk density of 1.41 g/cm$^3$), which is maintained until 40 cm depth (see Tab.1).

After applying each year of irrigation, the soil bulk density values ranging indicate a fairly wide range, from low values (moderately loose soil with the bulk density of 1.23 g/cm$^3$), to medium (soil poorly compacted, with bulk density of 1.46 g/cm$^3$).

In maize, arable horizon’s compaction after irrigation on the argic chernozem is more obvious, values of bulk density beeing between 1.24 g/cm$^3$ in 2009, and 1.28 g/cm$^3$ in 2011,
compared with 1.21 g/cm$^3$ in an irrigated soil. The long time application of irrigation causes soil compaction on the depth 10-20 cm, bulk density range of values going from moderately loose to irrigated (1.26 g/cm$^3$) to poorly compacted with bulk density of 1.38 g/cm$^3$ in 2011.

The influence of irrigation on bulk density for grain maize and winter wheat

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Irrigation</th>
<th>HDS 5% *</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Non-irrigate</td>
<td>Irrigate</td>
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<tr>
<td>0-10</td>
<td>1.21</td>
<td>1.24</td>
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<td>10-20</td>
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<td>30-40</td>
<td>1.37</td>
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</table>

**GRAIN MAIZE**

**WINTER WHEAT**

*HSD 5% - Tukey’s honestly significant difference procedure*

Bulk density values were not significantly influenced in the deeper soil layers (30-40 cm). In all the experimentation’s years, in grain maize same with winter wheat, it’s observed an increase of bulk density with depth and also a moderate compaction of soil on the depth 10-20 cm.

Increased bulk density occurs at the depth of seedbed preparation, seeding and crop maintenance, the indirect effect of irrigation (soil tillage is carried out at a higher water content), fine texture of the soil and at the same time due to decreasing of water stability of soil aggregates, so the soil became more susceptible to compaction.

The influence of soil tillage system on total porosity

The state of alignment of the solid particles of the soil can be expressed by the total porosity (TP), together with the bulk density. This soil properties provides information about the potential of aeration and water movement in soil (at big values of this parameter, soil has a high water retention capacity, high permeability and good aeration) (Burcea, 2009).

According to some researchers, on values of total porosity between 48 and 60% v/v, the plants’ roots and micro-organisms can find the best conditions for developing and growing (Florea et al., 1979).

The evolution of total porosity on grain maize

On irrigated plot, total porosity are assigned to the high value of this indicator on the depth 0-20 cm (values of 54% v/v), that determine a good permeability and water availability for maize plants. In the next 20 cm of soil the permeability decreases slowly, falling within the class of high values (total porosity decrease from 48% v/v to 50% v/v).
Total porosity evolution under irrigation for grain maize showed a small decrease in value over time throughout the soil profile (values are between 49% v/v and 55% v/v), or large to very large (Tab. 2).

The influence of irrigation on total porosity for grain maize and winter wheat

<table>
<thead>
<tr>
<th>TOTAL POROSITY (% v/v)</th>
<th>GRAIN MAIZE</th>
<th>WINTER WHEAT</th>
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<tr>
<td>Depth (cm)</td>
<td>Irrigation</td>
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<tr>
<td>30-40</td>
<td>48</td>
<td>50</td>
</tr>
</tbody>
</table>

*HSD 5% - Tukey’s honestly significant difference procedure

Under arable layer, the depth of 10-40 cm, total porosity is in the range of high values (49-51% v/v), which indicates a reduction in soil permeability.

For winter wheat, irrigation increased the total porosity, thus creating favorable conditions for aeration and water movement in the soil surface layer (0-10 cm); values of 52 and 54% v/v are from high to very high domain of this soil physical’s indicator.

In the next 10 cm, irrigation determined poor aeration of sub-arable layer in all three years of experimentation with medium values of total porosity (ranging from 45% v/v and 47% v/v).

On the depth 20-40 cm, throughout the experimental period 2009-2011, total porosity values are kept relatively constant, between 46% v/v and 50% v/v.

CONCLUSIONS

Application of long term irrigation, contributing to the increase soil’s bulk density, in particular in the layer on the surface, (the firsts 10 cm). The highest values of bulk density are found on the depth 10-20 cm, which makes the transition to another area of subsidence that is poorly compacted for irrigated plots and respectively moderately loose for non-irrigated one.

The highest values of bulk density are found on the depth 10-20 cm, which indicated a poorly compacted soil for irrigated plot, respectively moderately loose on non-irrigated one.

The values of total porosity are correlated with ones of bulk density and are higher in the superficial layers.

Soil irrigation influence the total porosity’s values, most of them indicate favorable conditions for plants growth and development.
REFERENCES