

Role of Ground Water in the Secondary Salinization of Meadow-Chernozem Soils in the Hajdúság Area

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Irrigation, by altering the natural water circulation in the soil, affects soil formation process significantly. This can reduce the fertility of the soil. Studying this effect of irrigation is very important, where this problem may arise.

In Hungary meadow-chernozem soils occupy about 15% of the cultivated area. Their percentage area is high where irrigation is practiced on a large scale.

We conducted our studies in Hajdúság, in the northern part of Hungary, beyond the Tisza area of the Great Plain. Here is located the East Main canal. In the neighbourhood of this canal a new irrigation system is being constructed. Meadow-chernozems occupy about 60% of the cultivated area. There are also lime-chernozem soils, and patches of meadow solonetz soils. The meadow-chernozem soils contain variable quantities of sodium salts at a considerable depth.

The salt content of the ground water is between 1500 and 3500 mg/l. The total salt content varies and may double during one year, depending mainly on the testing time, climate, irrigation and drainage conditions.

The ground water is at a depth of 2–4 metres over most of this area. The ground water level may increase during the summer in irrigated areas and remain nearer the surface than in the non-irrigated areas. Thus, under irrigation, the organic remains decompose more quickly and the mineral substances are transformed more intensively than without irrigation. This contributes to an increase in the ground waters' salt content towards autumn.

The salt accumulation layer occurs in the profile of the meadow chernozem soil in a band about 100 cm thick just above the water level. The thickness of the salty layer depends on the physical properties of the soil.

The chemistry of the soil salt accumulation is closely related to that of the ground water (Fig. 1). The ground water contains mainly hydrocarbonates and sodium.

Ion distribution in the salt accumulation layer is shown in Figure 2.

Sodium concentration (2 me./100 g) occurs just above the ground water level. Its quantity decreases towards the top of the accumulation layer to 1.1–1.2 me./100 g, at the upper edge.

The soil contains the least Ca (0.1 me./100 g) near the soil-water interface. It increases gradually upwards and, at about 100–120 cm from the water table, the soil content reaches 0.5–0.8 me./100 g.

The Mg content of the salt accumulation layer is about the same as

the Ca content. Its quantity increases upwards less than that of Ca and its maximum (0.3–0.4 me./100 g) coincides with the upper margin of the salt layer.

Hydrocarbonate distribution is interesting. Two maximums occur in the soil profile. The one maximum is above the ground water level (1.8 me./100 g) and the other is above the salt accumulation layer (1.0 me./100 g). The lowest content is at the upper edge of the salt accumulation layer (0.8 me./100 g).

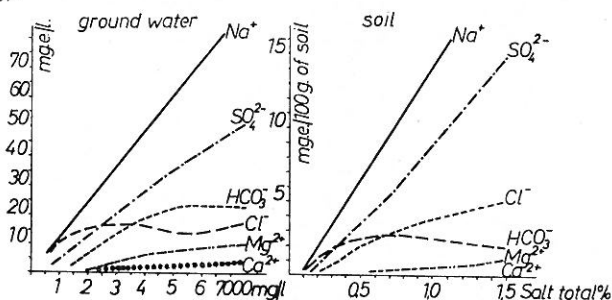


Fig. 1

Change of composition of the soluble salts with an increase in salt content

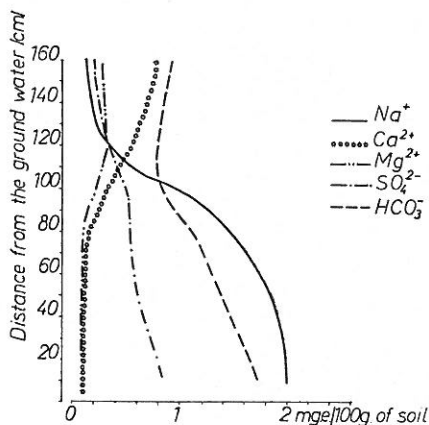


Fig. 2

Distribution of the different ions above the ground water

The soil profile has the highest sulphate content just above the ground water (0.7 me./100 g). The content decreases gradually upwards.

There is little chloride in these meadow-chnozem soils.

Where the height of the ground water increased, the salt accumulation layers moved closer to the soil surface and therefore the thickness of the fertile layer decreased. For this reason, the determination of the critical depth to ground water has great practical significance. In the meadow chnozem soils of the Hajdúság area the critical depth to the ground water is 2.3–27. m. The ground water is often above the critical level in the irrigated areas.