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Control of the spread of inorganic elements by shelterbelt in agricultural landscape

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Non-point pollution from agricultural lands involves primarily three transport processes: runoff, leaching, and erosion-sedimentation. The primary transport medium for all three processes is water, which is also a significant carrier of nutrients and sediments. Hydrologic processes important relative to non-point pollution are: (a) infiltration, (b) subsurface flow, (c) overland flow. A better understanding of the impact of shelterbelt on the decrease the quantities of chemical compounds in ground water should increase our ability to predict the improvement of the quality of ground water. The objective of this study was to evaluate the effect of shelterbelt on the decrease of calcium, magnesium and inorganic carbon in ground water passing through the shelterbelt from adjoining cultivated fields.

The investigations were carried out in Turew in Chlapowski's Agroecological Park situated 40 km South-West of Poznań (West Polish Lowland). Afforestations represent well developed network of shelterbelts (mid-field rows of trees afforestation). The established network of shelterbelts in Turew is the unique in Europe.

Ground water under cultivated field and shelterbelt from the artificial wells ones a month during 7 years from 2000 to 2006 was sampled and investigated. Ground water under shelterbelt flows away from adjoining cultivated field and passing through the shelterbelt. The first distance of this shelterbelt 104 m long is located on mineral soils (division-autogenic soils, order-brown forest soils, type-hapludalfs, subtype-glossudalfs) next from 104 to 125 m on mineral organic soils (division-hydrogenic soils, order-post-bog, soils, type-mucky soils, subtype-muckous).

Calcium, magnesium and mineral carbon quantities have been investigated in the ground water of shelterbelts.

The direction of water flow was estimated on the basis of the water level in the wells. Shelterbelt includes different species with the dominations of the maple, ash, beech, and hawthorn. Ground water samples were taken from the wells located (a) in the border between adjoining cultivated fields and shelterbelts, and (b) in the distances 62 m, 104 m and 125 m from the edge of the shelterbelt. The concentrations of calciumand magnesium and also mineral carbon were studied by examining ground water filtered by the filter paper Whatman GT/C. The concentrations of calcium and magnesium were investigated by the method by Hermanowicz. Dry masses were isolated by the freeze-dried and drying to the constant of weight at 105^{o}C. Total organic carbon, dissolved organic carbon and mineral carbon were measured on Total Organic Carbon Analyzer 5050A, ASI 5000A auto sampler, SSM – 5000A solid sample module, (Shimadzu, Japan).

Total amount of yearly rainfall was in 2000 – 671 mm, 2001 – 544 mm, 2002 - 495 mm, 2003 - 449 mm, 2004 - 672 mm, 2005 – 551 mm, 2006 – 578 mm. Mean temperatures ranged from 9.2 to 13.3^{o}C. The highest temperature +23.5^{o}C was measured in July 2000, and the lowest -6.4^{o}C observed in January 2006. The precision based on replicate analyses, were $\pm$ 4% for Ca^{+2}, $\pm$ 3% for Mg^{+2}, $\pm$ 4% for dry mass. All the determinations were run in triplicate, and the results were averaged.

The differences among the concentrations of calcium, magnesium and mineral carbon were attributed solely of width of the shelterbelt. Shelterbelt revealed the improvement in the quality of ground water.

Concerns over the environmental impacts of the elements of agricultural landscapes have focused attention on the study of calcium, magnesium, mineral carbon in ground water. These investigations have shown high contents of chemical compounds migrates ground water from cultivated fields. Ground water under cultivated field revealed

high concentrations of calcium, which yearly mean contents are equaled from 81.9 to 179.2 mg/l.

It was proved that biogeochemical barrier such as shelterbelt efficiency decrease the quantity of chemical compounds in ground water. The highest decrease of determined forms in the first distance of shelterbelt (62 m) and ranged for calcium from 26 to 34%, magnesium to 26% and mineral carbon to 71% was observed. On the basis of all aspects it seems that the first distance 62 m of shelterbelt is the most efficient for the function as biogeochemical barrier.