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Fertilizer Management in Watersheds of Two Ramsar Wetlands and Effects on Quality of Inflowing Water

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ABSTRACT / Two field experiments were carried out in the watersheds of two Ramsar wetland areas, Lakes Koronia and Volvi (area A) and Lakes Mikri and Megali Prespa (area B), to study the effect of application of N fertilizer on wheat yields, the quality of runoff water, and the quality of stream water. The treatments were a combination of two methods of fertilizer application (total amount in fall, and 2/3 in fall + 1/3 in spring) at three rates (0, 100, and 200 kg N/ha) with four replications. Concentrations of NH_4^+, NO_3^-, NO_2^-, P, and Cl^- and pH were determined in all water samples. Runoff water quality was not influenced by fertilizer application in either area. Chemical parameters for water did not differ along the selected watercourses in area B, while in area A they were higher in the samples taken near Lake Koronia than in the samples taken upstream, indicating that the watercourses are polluted downstream by nonagricultural sources. The differences in wheat yields between the 100 and 200 kg N/ha application rates were not high. These results call for better fertilizer management in order to achieve better yields and to diminish the possibility to have negative effects to the environment.

The water that feeds wetlands is directly enriched by nutrients and other constituents originating from various activities taking place in the watershed. Various management practices can affect the water quality of the nearby wetlands (Caporali and others 1981, Weller and others 1996). Agroecosystems receive various chemicals from atmospheric precipitation, irrigation water and crop residues, as well as direct application of pesticides, manure, and fertilizers (Powlson and others 1986, Goulding 1990, Richardson 1991, Couillard and Li 1993). Some agrochemicals are biologically utilized and are lost from the agroecosystems with the harvested crops, by the deep percolation of soil water, by runoff water, and as gasses into the atmosphere (Thomas and others 1992, Bussink and Oenema 1998, Carpenter and others 1998, Nagumo and Hatano 2000, Tsiouris and others 2002). Enell and Fejes (1995) reported that 69% of the annual N load to the Baltic Sea comes from rivers (point and nonpoint sources), 10% from N_2 fixation, and 21% from atmospheric deposition on the sea surface. Goss and others (1988) found that NO_3^- losses in the drainage, after N fertilizer was applied in the spring, were 6%–7% of the fertilizer applied. Scholefield and Stone (1995) reported that less than 10% of the N applied was found in the runoff water. Appropriate management of point and nonpoint pollution sources at watershed scale could reduce the pollution problems. Successful approaches need scientific tools that are useful to decision-makers.

Public concern about the impacts of agrochemical management on the quality of the surface water is growing all over the world. The objective of this work was to investigate the effect of N fertilization on the wheat yield and on the quality of the runoff water collected at the wheat field margin [i.e., acrofield (Tsiouris 1997)]. The quality of the runoff water was compared to the quality of rainwater and the quality of water in streams that flow into two internationally important wetlands (Ramsar sites) and receive chemical substances from point and nonpoint pollution sources.

KEY WORDS: Agricultural practices; Pollution; Runoff water; Stream water; Rainwater

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Materials and Methods

Study Areas

The study was conducted in the watersheds of two internationally important wetland areas in northern

trophic stage of Lake Koronia. The concentrations of NO_3^- in many samples of runoff water taken from the Prespa experiment site and those of Cl^-, NH_4^+ and P in samples of stream water taken from Mygdonia basin were above the maximum concentrations established by the EU for drinking water. Since the higher amount of N fertilizer used in this study did not make a high difference in wheat yields, it is wise to advise the farmers near wetlands to use lower amounts of N fertilizer or controlled-release fertilizer. Despite the fact that the agricultural nonpoint pollution in the studied watersheds is not serious, it would be desirable for the local Ramsar wetlands to implement an appropriate management plan. The management plan should aim to control the watershed land-use activities and introduce less intensive agriculture and more intensive treatment of the sewage originating from the local industry and human settlements. This study illustrates the need to view wetland management in the context of the management of the whole watershed. Wetland conservation in Greece is an impossible task without promoting the sustainable management of the ecosystems neighboring wetlands. A cardinal issue to this effect is wise use of fertilizers. The principle of wise use, however, can only be applied through field experimentation.

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