Studies on the Effect of City Wastewater on Physiological Response of Wheat

Neelima Akhtar

B.Sc. (Biology) - Chaudhary Charan Singh University, Meerut (India)
M.Sc. (Botany) - Chaudhary Charan Singh University, Meerut (India)

Research Supervisor: Prof. Arif Inam

ABSTRACT

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To appraise the suitability of city wastewater for the purpose of irrigation and as a source of nutrients, four pot experiments were conducted on Triticum aestivum L. during the rabi (winter) seasons of 2006-2009 at the net house of the Department of Botany, Aligarh Muslim University, Aligarh, India. All the experiments were carried out according to factorial randomized block design. The results are briefly described below.

Experiment I (Wastewater and Nitrogenous Fertilizer) was conducted in 2006-2007 to assess the effect of three water treatments (GW, 50%WW and 100%WW) together with four nitrogen levels (N_0, N_{40}, N_{80} and N_{120}). The aim of the study was to obtain the optimum dose of nitrogen with wastewater determined on the basis of growth and physiological parameters studied at tillering, heading and milky grain stages while yield characteristics and grain quality were observed at harvest. Growth characteristics included leaf number, tiller number, leaf area, plant fresh and dry mass. The physiological characteristics were carbonic anhydrase and nitrate reductase.
activity, NPK content in the leaves, chlorophyll content, net photosynthetic rate, stomatal conductance and water use efficiency. Finally at harvest yield characteristics examined were ear number plant\(^{-1}\), ear weight plant\(^{-1}\), length ear\(^{-1}\), spikelet number ear\(^{-1}\), grain number ear\(^{-1}\), 1000 grain weight, grain yield plant\(^{-1}\), straw and biological yield plant\(^{-1}\). Grains were analyzed for carbohydrate and protein contents.

Under wastewater irrigation (100%WW) increase in growth and physiological parameters as well as yield characteristics was observed over GW. Among the fertilizer doses, N\(_{120}\) proved best when applied with GW, however, with 100%WW it was at luxury consumption. Whereas the combination of lower fertilizer dose of nitrogen together with wastewater (100%WW\(\times\)N\(_{80}\)) proved optimum for most of the parameters studied including the yield and grain quality, thereby showing some economy of nitrogenous fertilizer.

Experiment II (Wastewater and Phosphatic Fertilizer) was conducted simultaneously with Experiment I to study the effect of wastewater treatments (as above) in presence of four levels of phosphatic fertilizer i.e. P\(_{0}\), P\(_{20}\), P\(_{40}\) and P\(_{60}\) on the performance of the same crop. In this experiment also 100%WW proved better than GW and 50%WW for most of the parameters studied. Among the phosphorus doses, P\(_{60}\) was the best and was at luxury consumption when applied with 100%WW. While the combination, 100%WW\(\times\)P\(_{40}\) was the optimum as it resulted in improved growth and physiological parameters which finally led to increase in grain yield, protein and carbohydrate contents.

Experiment III (Wastewater and Potassic Fertilizer) was conducted in 2007-2008 on the same crop under the same water treatments but in the presence of four levels of potassium i.e. K\(_{0}\), K\(_{15}\), K\(_{30}\) and K\(_{45}\). Here also 100%WW proved efficacious
in improving the growth and yield of the crop. The potassium dose K_{45} performed well without wastewater, however, it proved luxurious when applied with 100%WW. On the other hand, the combination of 100%WW and K_{30} was the optimum resulting in better growth, yield and grain quality of the crop.

Experiment IV (Wastewater and NPK Fertilizers) was conducted in the year 2008-2009 to evaluate the performance of the same crop under two water treatments (GW and 100%WW) along with different combinations of optimum doses of NPK fertilizers obtained from the Experiment I-III. Wastewater again proved effective in enhancing the plant growth and physiological characteristics which ultimately led to improved yield and grain quality. Among the fertilizer combinations, N_{120}P_{60}K_{30} without wastewater proved more effective in increasing nearly all the parameters studied and also proved good for the quality of grains in terms of carbohydrate and protein content. However, when interactions with wastewater were analyzed, the combination 100%WW\times N_{80}P_{40}K_{30} proved to be the optimum and significantly increased the yield and grain quality.

Overall, it was concluded from the experimental results that application of wastewater seems to pose no harm to the crop and instead could supplement, if not fully at least partly, the nutrient requirement of the crop leading to the reduction in fertilizer use and saving of the fresh water.

However, the presence of some pathogenic bacteria like coliforms, *salmonella* and *shigella* in wastewater may be a cause of concern for the growers. Among the four heavy metals Cd, Ni, Cr and Pb analyzed in wastewater, except Ni, the rest of the three were within the permissible limits.