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Sick Plants, Well Plants: Using Plants as Biological Indicators of Pharmaceutical Pollution

This project was designed to see if plants could be used as biological indicators for the presence and/or removal of pharmaceuticals in water and soil. Plants used were radish, pea, tomato, ryegrass, sunflower and squash. The pharmaceuticals, (at 1 ppm) used were Ampicillin, Tetracycline, Estradiol, Caffeine, Acetaminophen and Ibuprofen. The remedies were hydrogen peroxide and chlorine (oxidizers), and sodium bisulfate (acid- pH 1) brought back to neutral with sodium bicarbonate. Control plants were given distilled water only. The pharmaceutical controls were watered with 1 ppm pharmaceutical solutions. Each pharmaceutical was also treated with each of the three remedies; 5 ppm free chlorine, 0.1% H₂O₂, and pH 1 acid. Multiple plants in separated boxes were watered with the pharmaceutical and each of the three remedies for a total of 28 watering mixtures. Characteristics measured and compared included germination %, cotyledon size, plant height, true leaf width and the production of buds, blooms and fruit/seed. The project lasted for 171 days. Tomato and sunflower turned out to be the best biological indicators. All plants showed that chlorine treatment of the pharmaceuticals was the most successful. The acid remediation was the worst overall. The H₂O₂- acetaminophen remediation produced dwarfed tomatoes of 10 cm height, which stopped growing at 45 days. These plants were still alive at 171 days. Microscope slides of stems and roots of the different plants used showed some distortions of the Pith, Xylem, and Phloem.