Detoxifying Ability of Quinonoid-Enriched Humic Acids with Respect to Copper

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Catechol, hydroquinone and p-benzoquinone enriched preparations of humic acid (HA) were obtained by modification of HA of brown coal. Modification included phenolformaldehyde condensation of coal HA with catechol, hydroquinone or co-polymerization of HA with p-benzoquinone. All modified HA samples did not expose toxicity to plants.

Detoxifying ability of humic preparations toward copper was estimated using seedling bioassay. Wheat was used as a test plant. Length of 3-day roots was used as a test response.

HA detoxifying ability was quantified using toxicological constants of copper binding to HA are normalized to the organic carbon content in HA preparation (K_{OC}^{tox}) according to the following equation:

$$D = \frac{K_{OC}^{tox} \times C_{HA}}{1 + K_{OC}^{tox} \times C_{HA}}$$

where C_{HA} is a concentration of HA;

D is a detoxification coefficient calculated as follows:

$$D = \left(1 - \frac{R_d - R_{d+t}}{R_d} \Big/ \frac{R_o - R_t}{R_o}\right)$$

where: R_0 – root length of control; R_d - root length in the presence of HA; R_t - root length in the presence of copper; R_{d+t} - root length in the presence of copper and HA.

Modified preparations were shown to possess higher detoxifying ability compared to the initial HA. Detoxifying ability of the quinonoid-enriched humic acids was increasing in the following ascending order: native HA < hydroquinone-enriched HA < catechol-enriched HA < p-benzoquinone-enriched HA.

Thus, the chemical modification of humic substances is a powerful tool for creating new ecologically-sound sorbents aimed to control heavy metal pollution in the environment.

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