

Л. В. Литвиненко, А. В. Тищенко, И. Б. Ившина

## DECREASING THE COPPER ION PHYTOTOXICITY USING *RHODOCOCCUS* BIOSURFACTANTS

Lyudmila V. Litvinenko<sup>1</sup>, Artem V. Tishchenko<sup>2</sup>, and Irina B. Ivshina<sup>1,2</sup>

<sup>1</sup> *Institute of Ecology and Genetics of Microorganisms, Russian Academy of Sciences  
13 Golev Str., Perm 614081, Russia*

<sup>2</sup> *Perm State University  
15 Bukireva Str., Perm 614990, Russia  
E-mail: lkostina@mail.ru*

Received 4 May 2017, revised 27 November 2017, accepted 3 June 2018

Litvinenko L. V., Tishchenko A. V., Ivshina I. B. Decreasing the Copper Ion Phytotoxicity Using *Rhodococcus* Biosurfactants. *Povolzhskiy Journal of Ecology*, 2018, no. 3, pp. 290 – 299 (in Russian). DOI: <https://doi.org/10.18500/1684-7318-2018-3-290-299>

The effect of copper on the germination of seeds of several agricultural plants, namely, common vetch, white mustard and oats in the presence of *Rhodococcus*-biosurfactants was studied. As a result of the conducted studies it was established that *Avena sativa* L. was the most stable plant to the action of copper, and *Vicia sativa* L. was a less stable plant. By the copper resistance degree, the plants used in the work could be arranged in the series: *Avena sativa* L. > *Sinapis alba* L. > *Vicia sativa* L. Copper in concentrations from 50 MPC and above had a pronounced inhibitory effect on the germination of seeds. The pretreatment of seeds with *Rhodococcus* biosurfactants and seed germination under the conditions of copper contamination have been established to contribute to an increase (up to 4.5 times) in the germination, germinative energy and viability of oats, mustard and vetch sprouts. An ecologically safe method has been developed for reducing the toxic effect of copper on the growth of the following plant crops: *Avena sativa* L., *Sinapis alba* L., and *Vicia sativa* L. in the presence of *Rhodococcus* biosurfactants.

*Key words:* *Rhodococcus* biosurfactants, heavy metals, copper, *Avena sativa*, *Sinapis alba*, *Vicia sativa*.

DOI: <https://doi.org/10.18500/1684-7318-2018-3-290-299>

**Acknowledgments:** This work was supported by the Complex program of Fundamental research of the Ural Branch of the Russian Academy of Sciences (project no. 18-4-8-21) and the state task (state registration no. 01201353247).

## REFERENCES

Gigiyenicheskiye normy 2.1.7.2041-06. “Pochva, ochistka naseleennykh mest, otkhody proizvodstva i potrebleniya, sanitarnaya okhrana pochvy. Predelno dopustimyye kontsentratsii (PDK) khimicheskikh veshchestv v pochve” (GN 2.1.7.2041-06. Soil, purification of populated areas, residuals. Threshold limit concentration of chemical substances in the soil), 2006. Available at: <http://www.gosthelp.ru/text/GN217204106/Predelnodopust.html> (accessed 23 March 2017) (in Russian).

Kostina L.V., Kuyukina M.S., Ivshina I. B. Evaluation of *Rhodococcus* biosurfactant potential towards the remediation of heavy metals from contaminated soils of Sverdlovsk region. *Bulletin of Perm University. Biology*, 2014, iss. 4, pp. 73 – 78 (in Russian).

## СНИЖЕНИЕ ФИТОТОКСИЧНОСТИ ИОНОВ МЕДИ

Litvinenko L. V., Tishchenko A. V. Effects of *Rhodococcus*-biosurfactants on the lead ion phytotoxicity. *Bulletin of Perm University. Biology*, 2017, iss. 1. pp. 80–87 (in Russian).

*Metodicheskiye rekomendatsii 2.1.7.2297-07. "Obosnovaniye klassa opasnosti otkhodov proizvodstva i potrebleniya po fitotoksichnosti"* (MR 2.1.7.2297-07. Justification of the hazard class of production and consumption waste on the ground of its phytotoxicity), 2007. Available at: [http://www.oхранatruda.ru/ot\\_biblio/normativ/data\\_normativ/52/52957/](http://www.oхранatruda.ru/ot_biblio/normativ/data_normativ/52/52957/) (accessed 18 March 2017) (in Russian).

*"Ob utverzhdenii Kriteriyev otneseniya otkhodov k I – V klassam opasnosti po stepeni negativnogo vozdeystviya na okruzhayushchuyu sredu"* : Prikaz Ministerstva prirodnykh resursov RF ot 04.12.2014 goda no. 536 ("On Approval of the Criteria for the Recognition of Waste to I-V Classes of Danger by the Level of Negative Impact on the Environment": Order of the Ministry of Natural Resources of the Russian Federation no. 536 of 04.12.2014). Moscow, 2015. Available at: <http://publication.pravo.gov.ru> (accessed 23 March 2017) (in Russian).

Petukhov A. S., Petukhova G. A. Morphophysiological response of plants to environmental pollution by heavy metals. *APRIORI, Ser. Natural and Technical Sciences*, 2015, no. 3, pp. 1–6 (in Russian).

Titov A. F., Talanova V. V., Kaznina N. M., Laidinen G. F. *Ustoychivost rasteniy k tyazhelym metallam* [Plants' resistance to heavy metals]. Petrozavodsk, Karelskiy nauchnyy tsentr RAN, 2007. 172 p. (in Russian).

Ivshina I. B., Kuyukina M. S., Philp J. C., Christofi N. Oil desorption from mineral and organic materials using biosurfactant complexes produced by *Rhodococcus* species. *World J. of Microbiology and Biotechnology*, 1998, vol. 14, pp. 711 – 717.

Kuyukina M. S., Ivshina I. B., Philp J. C., Christofi N., Dunbar S. A., Ritchkova M. I. Recovery of *Rhodococcus* biosurfactants using methyl-tertiary butyl ether extraction. *J. Microbiological Methods*, 2001, vol. 46, pp. 149–156.