MATHEMATICAL SIMULATING AND ANALYSIS OF MICROEVOLUTIONARY PROCESSES IN LEGUMINOUS-RHIZOBIAL SYMBIOSE

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At present an extensive knowledge of ecogenetic processes in leguminous-rhizobial symbioses has cumulated (a competition at inoculation and colonization of rhizosphere and nodule niches; bacterial surviving in soil niches, etc.). However, system-wide appearances (intercomponent feedbacks, the functional integration of partners; ecological efficiency of symbiosis) remain are unavailable to researches because of major duration of necessary observations. In this connection it is offered to analyze system-wide processes by means of mathematical model of a microevolutionary cycle of symbiosis (MMS).

For adequate representation in MMS all known private processes we have organized the calculations in the form of four sequentially join blocks. Each block contains the formulas presenting processes of appropriate stages of a microevolutionary cycle. The first block generates of processes of bacterial mutations in a soil niche. The second block generates of bacterial competition at an inoculation of rhizosphere and nodule niches, and also the competition of two genotypes at seed germinating. The third block generates of bacterial competition for colonization of rhizosphere and nodule niches, and also seed formation by plants. The fourth block generates the bacteria surviving in a soil niche.

Distinctive characteristic of MMS is the registration of two system feedbacks between plants and bacteria. The first connection reproduces a linear dependence of plant productivity from bacterial nitrogen-fixing activity in nodule niche. The second connection reproduces increase in rate of bacterial colonization in nodule niches by the nitrogen-fixing bacterial strain depending on nitrogen content fixing in preliminary microevolutionary cycle.

Model analysis has been conduct with help a method of parametric disturbances (i. e. each parameter of model was increased by 1% with fixing of others parameters on base level) and partners frequencies of symbiosis at a final state was rated. In this way succeeded in definition of partner's response from external actions. Analysis of the resulted covariation matrix (the eigenvalues, the eigenvectors) has allowed to calculate the integration level of the biosystem's partners and to show nontrivial correlation between the integration level of symbiose's partners and the ecological efficiency of symbiose.

Work is done at a support of the RFFR-09-04-00907-a grant.