Selection of native bacteria from rice soils resistant to glyphosate, clomazone and kifix, to be used as biodegrading agents

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Rice is the main crop worldwide, covering about 11% of the planet's arable land and constitutes a strategic component of the diet adopted for more than half of the world population. In Argentina, 3% of its production is in the Province of Chaco. Glyphosate, clomazone and kifix, are herbicides commonly used in rice crops for weed control, generating alterations in the soil ecosystem, and affecting the trophic chain. In this province, several studies reported poisoning cases in humans by herbicide applications, particularly in La Leonesa. Consequently, local producers requested assistance to find a prompt solution for this environmental concern. As demonstrated, the ability of certain soil bacteria to degrade these types of pollutants ensures an onsite detoxification process. For this reason, the objective of this work was to isolate native bacteria from soils of rice crops, resistant to a mixture of agrochemicals composed by the commercial formulates of glyphosate, clomazone and kifix, to be applied in biodegradation tests. The soils samples were taken from 3 areas of a field intended for rice cultivation, located in La Leonesa: 1. Virgin area without registered pesticide applications (ZA), 2. Area without applications for a decade (ZB), and 3. Crop area with continuous application of agrochemicals (ZC). As a first approach, counts of cultivable microorganisms were carried out in a traditional nutrient medium (PCA) and an oligotrophic medium (AS= soil agar) with and without pesticides (CP and SP respectively). Differences were detected both in number and in the diversity according to the sampling area, the composition of the medium and the presence of pesticides. In parallel, mixed cultures were obtained from soil suspensions in a saline broth (M9) with 0.5% m/v glucose and 1% v/v of the same herbicides, obtaining new isolates in M9 agar (AM9). As a result, 24 strains were selected and purified from AS-CP, PCA-CP and AM9. Toxicity was evaluated by exposing these isolates to increasing concentrations of herbicides in agar cultures, registering a greater growth inhibition in AS-CP with respect to PCA and AM9, probably related to pesticide interactions with medium components lowering the bioavailability. From these tests, 16 strains were selected according to their resistance to the highest concentrations of the mixture (from 0.25% in AS-CP to 15% in PCA-CP). Finally, resistance assays were performed in M9 broth supplemented with increasing concentrations of herbicides (1-20% v/v), detecting 9 strains capable of developing up to 15% v/v. In further studies, pesticide biodegradation by-products will be screened in cultures supernatants. Regarding that the agrochemical applications in crops will eventually not be discontinued, this work represents the first step to develop an alternative based on native bacteria bioinoculants for the future quality recovery of Chaco rice production soils.

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