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Ph. D Topic: Role of salicylic acid in pesticide resistance in cyanobacteria

Abstract

Overpopulation had increased the food demand tremendously which has resulted in a gap between the production and demand. To fill in the gap, farmers started using pesticide, herbicides indiscriminately. Paraquat dichloride (methyl viologen) is widely used in rice field to combat the problem. Ultimately, it reaches to the water bodies and food chain then cause deleterious effect. PQ exert its toxic effect through oxidative damages in prokaryotes and eukaryotes, and interfere in electron transport system that block the photosynthetic and respiratory pathways of photosynthetic organism.

Salicylic acid is a lipophilic derivative of benzoic acid. It is considered as a stress hormone because it activates the defence response in the organism for counteracting toxic effect by modifying the physiological and biological processes of the organism. Similarly, calcium is also involved in stress signaling pathways as a secondary messenger by coupling with phytohormones and other signaling molecule to enhanced the stress resistance activity of the organism.The present study was conducted to find out the role of ameliorating agents like salicylic acid and its combination with calcium in paraquat exposed cyanobacterial biofertilizer (*Microchaete sp.* NCCU-342)

In this study, cyanobacterium- *Microchaete sp.* NCCU-342 was grown under paraquat exposure (- 0.1, 0.2, 0.4, 0.6, 0.8, 1.0 µM for narrow range and 1.0, 1.2, 1.4, 1.6, 1.8, 2.0µM for wide range). After determining adverse effect of PQ on growth, specific growth rate and

LD_{50} was done. To find out the mitigating role of salicylic acid alone and in combination with calcium by selected biochemical parameters (pigments, protein, carbohydrates, MDA, hydrogen peroxide, antioxidant enzymes, non-enzymatic antioxidant compounds, phytohormones and osmolytes).

The results obtained in the present study has been summarized below:

1. Paraquat shows toxic effect on the growth of *Microchaete sp.* NCCU-342 in a dose-dependent manner. The maximum growth rate was found in control culture (0.3662 h−1), whereas the specific growth rate decreased from 0.3232 h-1 (at the lowest PQ concentration) to 0.1987 h-1 (at the highest PQ concentration) after 96 hours. The 50 % survival (LD_{50}) of the test organism under paraquat stress was calculated as 0.62 µM. The cultures supplemented with exogenous salicylic acid (0.3 mM SA) higher growth then other concentration of salicylic acid (0.1 and 0.5) as compared to paraquat exposed culture. Further, the combination of salicylic acid (0.3 mM) and calcium (2mM) under paraquat exposed culture showed maximum growth then other culture sets.
2. Cyanobacterial Photosynthetic pigments and protein showed notably reduction with increasing concentration of paraquat. However, carbohydrate MDA and hydrogen peroxide were increased progressively.
3. Supplementation of salicylic acid alone and in combination with calcium improved the pigment, protein and the carbohydrate content in *Microchaete*. The free radical levels (MDA hydrogen peroxide and electrolyte leakage) decreased to further ease out the PQ stress.
4. In order to provide protection under PQ stress the cells increased the antioxidant enzymes (SOD, CAT, APX, GR and GPX), osmolytes (proline and sucrose), phytohormones (indole acetic acid and salicylic acid) the nonenzymatic antioxidant (glutathione and

phenolic compounds). The enhancement was further supported by salicylic acid alone and in combination with calcium against PQ stress.