



## **Stress responses of *Azolla* sp. and its symbiotic *Anabaena azollae* against oxyfluorfen**

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### **Abstract**

Non-target aquatic plants in agricultural lands are highly vulnerable to various stresses including agrochemicals. The present study assessed the stress responses of aquatic macrophyte *Azolla* sp. and its symbiotic *Anabaena azollae* against a common herbicide; oxyfluorfen. The capability of atmospheric nitrogen fixation by *Anabaena azollae* is an added advantage for *Azolla* and its living environment. *Azolla* sp. (2 g fresh weight) was exposed to six different concentrations of oxyfluorfen [0 (control), 60, 80, 100, 120, and 140  $\mu\text{gL}^{-1}$ ]. These concentrations were selected based on several preliminary trials. Each treatment with three replicates was randomly allocated into 18 experimental units in a complete randomized design and the experiment lasted for 96 hours under laboratory conditions. The plant growth, pigment content (chlorophyll and anthocyanin),  $\text{H}_2\text{O}_2$  concentration, peroxidase activity (POD), and Indole acetic acid (IAA) content of *Azolla* sp were measured at the end of the experiment while the microscopic observations were recorded daily. The growth rate of *Azolla* sp. was significantly different among treatments ( $P < 0.05$ ). The chlorophyll-a and anthocyanin content were significantly reduced by the oxyfluorfen ( $P < 0.05$ ), where the highest concentrations of chlorophyll-a (460  $\mu\text{g/g}$  Fresh Wt) and anthocyanin (0.6  $\mu\text{g/g}$  Fresh Wt) were found in the control and 100  $\mu\text{gL}^{-1}$  treatments respectively. Increased  $\text{H}_2\text{O}_2$  concentration and the POD activity together with low IAA content indicated oxidative stress in plants exposed to oxyfluorfen. Except in the control, roots of *Azolla* exposed to oxyfluorfen detached after 24 hours of exposure, while plants became pink in colour in 80, 100, 120, and 140  $\mu\text{gL}^{-1}$  treatments. Shrinking of the filaments of *Anabaena azollae* was observed in each concentration of oxyfluorfen at 96 hours of exposure and the absence of filaments was observed in plants exposed to 140  $\mu\text{gL}^{-1}$  concentration. The stress caused by oxyfluorfen on *Azolla* sp. disrupted its symbiotic relationship with *Anabaena azollae* at the concentration of 140  $\mu\text{gL}^{-1}$  after 96 hours of exposure. Further studies are recommended to observe the possible recovery process of *Azolla* sp. and *Anabaena azollae*.

### **Keywords**

*Azolla* sp., anthocyanin, oxyfluorfen, peroxidase, indole acetic acid