RESEARCH PAPER

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# Phosphorus effect on growth, biochemical changes and yield of rice plant during submergence

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An experiment was conducted to see the influence of phosphorus during submergence of rice at experimental site of Department of Crop Physiology, N.D. University of Agriculture and Technology, Kumarganj, Faizabad, UP, India. The two rice varieties *i.e.* FR13A (submergence tolerance) and Mahsuri (submergence susceptible) were exposed to seven days continuous complete submergence to 30 days of old seedling with different doses of phosphorus. Plant height, shoot dry weight, starch content, SOD activity and grain yield significantly reduced during submergence in both varieties irrespective of phosphorus treatment. Among the different levels, 80 kg $P_2O_5$ $ha^{-1}$ phosphorus was found more effective during submergence. As it sustained the growth and yield by increasing the shoot dry matter, starch content, and SOD activity of rice during submergence. The response of phosphorus was more significant in FR13A than Mahsuri. Therefore, the optimum phosphorus content in plant maintained growth activity by mitigating the adverse environmental effect under submergence condition.

Key words : Phosphorus, Submergence, SOD, Starch, Yield and rice

## INTRODUCTION

Rice is the staple food crop of India as well as many parts of the world. More than 80 per cent of our countrymen depend fully or partially on rice. Rice production faces a number of constraints. Among these, submergence due to flooding is well spread in South Asia, Bangladesh and North-East India and it affects approximately 22 m.ha (about 16 % of world rice area) including 15 million ha of potential flash flood (short duration flood) in rainfed lowland rice area and five million ha of deep water rice (Khush, 1984). Submerged rice plant experiences two drastic environmental changes:

The change from aerobic to anaerobic conditions during submergence and second subsequent change from anaerobic to aerobic conditions when the flood water resides. During submergence condition, $O_2$ concentrations are usually below air saturations and hypoxia or anoxia conditions. Levitt (1980) cited several mechanisms involved in adaptation to $O_2$ deficiency during flooding but failed to include interactive effect associated with other environmental factors during partial or complete submergence. Limited gas diffusion is most important factor during flooding (Setter *et al.*, 1995). Since gas diffusion is $10^{-4}$ fold slower in water than in air (Armstrong, 1979), the depletion of $O_2$ is the major feature of the flooded field which creates a condition of low $O_2$ (hypoxia) or no $O_2$ at all (anoxia) around the plant tissue (Kennedy *et al.*, 1992). Carbon assimilation during submergence will be affected by several factors including $CO_2$ supply, irradiation and a capacity of plants to photosynthesis under water. Phosphorus plays an important role in plant growth. It also stabilizes the survival and yield of rice plant by manipulating the metabolic activities during submergence. Present study concerned with the enhancing flooding tolerance in susceptible genotypes of rice by application of optimum amount of phosphorus.

## MATERIALS AND METHODS

Experiment was conducted with rice varieties FR13A (submergence tolerant) and Mahsuri (submergence susceptible) at experimental site of Department of Crop Physiology, N.D. University of Agriculture and Technology, Kumarganj, Faizabad. For creation of different level *i.e.* 0 (control), 40,80 and 120 kg $P_2O_5$/ha phosphorus treatment, the desired amount of single super phosphate was dissolved in water and sprayed on to the well pulverized soil and mixed thoroughly. Half of the nitrogen and full amount of the potash were also added to the phosphorus solutions before mixing to the soil. Two sets of the same material were prepared. First set was kept as control (without submerged) whereas the second set was completely submerged at 33 days after sowing (DAS) for seven days in submergence tank containing natural flood water. Twenty pots per treatment were