INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Drought is one of the worst natural disasters that affect the economic, social, and environmental status of any country. The long-term drought affects the soil ecosystem and can initiate desertification and deterioration of soil health. This leads to severe water distress, which is further aggravated by improper water management, poor irrigation practice, degradation of soil quality, and low water holding capacity of soil. Effective land management is the most feasible solution during drought. One of the ways for handling water stress conditions is the use of water absorbing polymer (WAP) that can absorb and store water within its polymer network and transfer the stored water to plant roots under the water stress condition. Encouraging the utility of WAP for drought management would necessitate clarity in the understanding of WAP-soil interaction. Therefore, objective of this study is to evaluate the performance of WAP for drought stress management considering WAP-soil interaction.

To begin with, a novel, eco-friendly WAP was synthesized by transforming an industrial solid waste, fly ash (FA). The synthesis process was optimized to achieve maximum water-absorbing capacity (WAC). The transformed FA-WAP exhibited high WAC (310 g/g and 230 g/g in distilled and tap water, respectively), very much comparable with the commercially available WAP. The study quantified the swelling kinetics and characterized the re-swelling behavior of the FA-WAP under alternate wetting-drying cycles and compared with the commercial WAP. The performance of the synthesized FA-WAP and commercial WAP was evaluated as a soil amendment for improving the drought tolerance of soil. The water transport mechanism from swollen WAP to soil particles was characterized in a diffusion cell by placing the swollen WAP and dry soil in contact with each other. The water retention characteristics curve (WRCC) of the WAP amended soils (both drying and wetting curve) at three different concentrations (0.1%, 0.2%, and 0.4% on weight by weight basis) were evaluated with both the WAPs to assess the efficacy of WAP for the effective management of water resources during drought. Predictive models were proposed to estimate the drying WRCC of WAP amended soils and the hysteresis in WRCC of WAP amended soils with multiple drying-wetting cycles. The study not only demonstrated the usefulness of FA-WAP for increasing the irrigation intervals and thereby saving water during drought conditions but also offering an eco-friendly solution to mass utilization of industrial solid waste, FA for a meaningful application in drought management.