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# UREA: ADIPIC (2:1) CO-CRYSTAL AS A SLOW RELEASE NITROGEN SOURCE

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Slow and sustained release fertilizer system was introduced using urea containing co-crystals. Urea is the most widely used plant nutrient as the nitrogen source. However, nutrient use efficiency (NUE) of urea is very low due to high solubility, hygroscopicity, and volatilization in the form of ammonia and nitrogen oxides. In addition, urea can be incorporated into soil organic matter promoting many environmental issues. During this study, attempts were made to evaluate the potential of a novel urea-based cocrystal polymorph [urea: adipic acid (2:1)] as a slow and sustain release fertilizer. Urea: adipic acid (2:1) cocrystal was synthesized by the liquid assisted grinding technique in the presence of a few drops of methanol as the solvent. The successful cocrystal formation was confirmed by powder X-ray diffraction, differential scanning calorimetry, thermogravimetric analysis and Fourier transform infrared spectroscopy. The release behavior of prepared fertilizer was investigated in the soil medium (pH = 5.1), and it was observed that nitrogen release from the cocrystal composition was in a slow and sustained manner up to 18 days whereas pure urea had released 80% of nitrogen within 6 days. The carbonyl group of urea acts as a very strong acceptor center while two amine groups offer rich donor capabilities resulting in hydrogen bonds with adipic acid. Such non-covalent interactions between urea and adipic acid would reduce the rate of dissolution and hydrolysis of urea to gaseous products. The proposed cocrystal based composition can be a potential candidate for the development of an efficient fertilizer formulation.

**Keywords:** Liquid assisted grinding, Release behavior, Slow release fertilizer, Urea co-crystal