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Editorial

Superabsorbent Polymers: Artificial Mini Water Reservoirs in Soil for Agriculture Applications

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Drought is the largest abiotic stress that hinders the growth of plant and thus reduces the crop yield. The frequency and harshness of drought conditions may lead to face of climate change. Beside arid situations, the three most common soil conditions i.e. low water retention capability, leaching of soil moisture and high rate of evaporation and transpiration, are the major factors of reducing agriculture productivity. Apart from these, factors like soil salinity, reprehensible irrigation practices, low or overuse of synthetic fertilizers and pesticides also severely affect plant growth, often rendering permanent damage to soil-biota. Moreover, a shortage of water availability for routine irrigation is also an issue for many countries. In addition, with increasing population growth, usable water (i.e. ~ 0.3% of earth's water) demands are predicted to rise in future. Therefore, finding new ways to improve water availability and its efficient use in the agricultural sector is essential. One of the ways is the change in soil management that can affect the quantity of deep drainage replenishing ground and sub-surface water. The introduction of good soil management practices will decrease the proportion of rainfall that is lost as runoff, which will increase base flows and decrease peak flows in soil and thus reduce the incidence of flooding as well. Conversely, an improvement of nutrient management in soil will lead to higher grain and foliage production.

The use of superabsorbent polymer (SAP) is one of most attractive approaches of nourishing the soil and its uses may vary depending upon region, environment and crops. SAPs are prepared using monomeric/polymeric precursor units and are considered as soil conditioners that have the capacity to absorb and hold 300 to 500 times of water of their initial mass. SAPs form granules upon swelling in soil to enhance soil properties by aeration. Due to their quick and high water retention capacity, SAPs are currently used in various fields including personal care (adult incontinence products, sanitary napkins, diapers, urinary bags etc.), healthcare (wound dressing, medical waste solidification, absorbent mat etc.), agriculture and horticulture (soil broadcasting, seed coating, root dipping, flower bed, ornamental gardens, etc.), food packaging and oil drilling.

The SAPs used in agriculture applications are usually synthesized from acrylic acid monomers and polyacrylamide co-polymer using various polymerization approaches (like, suspension polymerization, solution polymerization and gel polymerization). The crosslinked polymer i.e. polyacrylate is non-toxic, non-irritating and non-corrosive in nature. It is tested to be biodegradable with an annual rate of degradation 10-15% and Absorption Capacity Index (ACI) in the scope of 30 - 100. However, some natural polymers like polysaccharides and polypeptides are also being used for various SAP formulations. The demand of SAPs prepared from natural precursors is increasing in global SAP market because they are the least expensive and most abundant available renewable organic materials.

The application of SAP is a well-established water conservation approach in agriculture. It is widely used in different parts of the world for fulfilling the increased demand of food to growing population, which is the key factor driving the demand for the SAP market in agriculture application. Various advancements are monitored in the preparation of SAP formulations in last few decades, which involve co-polymerized composites for optimum stability and absorbency under load (AUL), control release of plant growth promoting factors, and also bio-based antifungal and antimicrobial SAP preparations. Due to their nature, SAPs can be known as mini-reservoirs of water and nutrients in soil for on-demand supply to plants to produce grain and increase biomass under limited nutrient and irrigation conditions. Their water storage capacity can lasts for up to five years. They help and improve the rate of seed germination, root growth during drought stress and also reduce transplanting stresses in plants. Additionally, use of SAP application in soil also acts as an insulating material to plant roots to reduce stress during frosty winters and also reduces the use of fertilizers by 15 to 30%. The agricultural industry is the fastest-growing market for super absorbent formulations. A recent report published by Allied Market Research, forecasts that the global market of SAP was valued at $6,174 million in 2015, and it is expected to acquire $8,551 million by 2022, which is registering a compound annual growth rate of 4.7% during the period 2016 - 2022. The superabsorbent polymers are presenting tremendous growth and attracting scientists and global market leaders for its advancement, low-cost production and potential utilization in agriculture to fulfil the societal requirements in the deteriorating climate conditions and global warming [1-3].

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