

Polysaccharide based hydrogels have been proposed as promising soil conditioner due to its nutrient and water sorption capacity and biocompatibility. However, these materials usually have insufficient mechanical strength and are degraded too quickly in the soil environment. The solution to these problems may be to use of specific fillers, e.g. biochar, hydrochar, activated carbon, which can additionally increase hydrogel ability to bind various ions and molecules. So far, several researchers have attempted to determine the sorption capacity of hydrogels filled with substances high in organic carbon content. But there are no studies on their impact on individual soil parameters as well as plant growth and development. In line with the Agenda for Sustainable Development 2030, all new materials should be produced, whenever possible, from waste to transform our economies towards a circular economy. INSECT therefore chose the waste from one of the fastest growing industries based on insect breeding for the production of hydrogel materials.

The main aim of INSECT is to synthesize and evaluate new and eco-friendly hydrogel composites (HGC) prepared from waste of the insect industry and study their effect on soil properties and plant growth. Four hydrogel composites with various fillers will be prepared: chitosan-based hydrogel filled with biochar, hydrochar, activated carbon, and frass (insect excrements). Their properties and effects will be compared with those of hydrogel without any filler. Chitosan, biochar, hydrochar and activated carbon will be prepared using dead imagoes of *Hermetia illucens* (black soldier fly). The specific objectives are to determine the following characteristics of the developed materials: (1) physicochemical parameters, nutrient content, sorption abilities towards water and heavy metal ions, (2) ecotoxicity in the soil and water samples, (3) effects on soil physicochemical parameters, nutrient content, heavy metal sorption and microbial activity over time, (4) degradation rate in the soil, (5) impact on plant growth under drought and heavy metal contamination conditions, (6) effect on soil hydraulic properties and structure, (7) effect on aggregation and soil mechanical stability. The experiments will be conducted in Germany and Poland on sandy soils with different land use and origins as well as low water holding capacities and wettabilities, which could potentially be improved by the application of HGCs.

Hydrogel composites are exposed to provide all the benefits of biochar, hydrochar, activated carbon or frass combined with the positive aspects of hydrogels, i.e., ability to minimize the negative effects of drought and to facilitate reclamation of degraded soils. The properties of the developed hydrogel composites in INSECT are expected to outperform those of conventional hydrogels without fillers.