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A conceptual framework to better understand interactions between seedbed abiotic and biotic factors under the influence of cropping systems and their overall impact on field crop establishment

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Seed germination and seedling emergence are the very beginning phase of a crop cycle and thus determine success or failure of any crop establishment. This early phase is affected by five major groups of drivers namely seed and seedling characteristics, seedbed physical components, seedbed chemical components, seedbed biological components, and cropping systems. While several studies have been carried out on these drivers, they mainly focused on only one or a few factors without taking into account their overall interactions and impact on seed germination and seedling emergence. Therefore, there is a need to adopt a systems-level approach for a better understanding of these interactions and their overall effect on the quality of crop establishment. In particular, a focus is needed on the impact of cropping systems on the functioning of plant- and soil-associated organisms. It is important to combine experimental approaches, regional agronomic diagnoses and simulation modeling in order to tackle the question. Such a holistic approach will allow designing of more resilient and environment-friendly agricultural systems less reliant on synthetic inputs. Such agroecological systems are the only alternative to feed the increasing global population, on one hand, and to minimize negative impacts on the human health and biodiversity, on the other.