Cover crops play an important role in maintaining soil health and provide sustainable alternatives in agroecosystem management. Multiple terms are used interchangeably to describe them, depending on objective(s) of planting, such as green manures (add residues), cover crops (prevent erosion), and catch crops (trap nutrients from loss). However, cover crops are planted during or after the main crop and are usually killed on the surface or incorporated into the soil before they mature.

Cover crops are planted mainly to (1) suppress weed germination, (2) add biomass and nitrogen in the case of legumes, and (3) physically protect against wind and water erosion. But, they provide multiple benefits directly and indirectly that are not foreseen by farmers (see Fig. 1).

Cover crop residues alter many growth factors like light, soil temperature, and soil moisture; provide physical impedance; and release allelopathic chemicals that control weed germination and establishment. Most weed species require light to initiate the germination process, and the presence of cover crops reduces light transmittance depending on canopy structure. Cover crops that have a greater proportion of leaf area and less stems like hairy vetch or rye should be best adapted for controlling weeds. Alterations of soil moisture and temperature by a cover crop canopy can either benefit or retard weed seed germination, depending on weed species, soil characteristics, and climate. Under drought condition, the canopy provided by cover crops could enhance soil moisture retention and enhance weed emergence. Cover crop residue probably inhibits the emergence of germinated weed seeds by forming a mechanical barrier to the upward growth of the seedlings. Release of toxins from cover crops has been postulated to restrict weed seed emergence, but establishing the allelopathic relationship between cover crops and weed species is a challenge. Under a conservation tillage system, cover crops have the potential to control weeds.

Cover crops add small residual biomass to soil, but rapid decomposition of residues has the potential to increase the active organic matter pool. Cover crop mixes can be formulated to control the sequestration rate based on the carbon to nitrogen ratio of the species. A residue with low C:N ratio below 20:1 will mineralize the nutrients faster than a cover residue.