

# Alfalfa Enhances Above & Belowground Biodiversity

*Marisol Berti, North Dakota State University*

**B**iodiversity is the different kinds of living organisms you find in one area (e.g., plants, animals, fungi, microorganisms). It is key to maintaining healthy, resilient, stable cropping systems. As it decreases, systems are more susceptible to biotic/abiotic stresses leading to reduced productivity and detrimental environmental effects. Alfalfa provides ecosystem services including biodiversity restoration.

Midwest rotations had 5-8 crops with alfalfa as a mainstay until the late 70's. Conventional production now relies on heavy inputs (e.g., fertilizers, pesticides), and tech improvements, causing a drastic decline in crop species diversity. The Corn Belt Region has the lowest/steepest diversity decline since 1978 compared with other regions.

In addition to alfalfa's importance to human food production (e.g., milk, cheese, ice cream), it is also at the beginning of the food chain, supporting many arthropods (e.g., insects, spiders, mites), small herbivores (e.g., ground squirrels, mice), and large mammals (e.g., deer). Indirectly, many other birds, mammals, snakes, and other species, feed on the small herbivores feeding on alfalfa. It is the only green crop in late fall/early spring available to feed wildlife. Over 100 species of birds, mammals, amphibians, and reptiles are users of alfalfa. Above ground, alfalfa's high leaf protein content and canopy cover attracts arthropods, including insect predators (99% of the insects present are beneficial). It is cross-pollinated and its flowers attract pollinators, providing them pollen and nectar (Figure 1). Many arthropods (e.g., ground beetles, spiders) live below the canopy, providing many microecosystem functions. The number and species diversity of ground insects and spiders is greater in alfalfa than in other annual crops (California has >1,000 species inhabiting alfalfa).

A preliminary North Dakota study looking at arthropod biodiversity in alfalfa compared to annual crops (e.g., soybean, corn, wheat, sunflower) observed greater diversity in alfalfa. Insects were collected weekly using sticky traps for flying insects and pitfall traps for crawling arthropods (Figure 2). Thirty different arthropod families were observed and were the same for all crops; however, the species attracted by each crop were different. Sticky traps are yet to be quantified, but visual observation indicates greater arthropod diversity in alfalfa (Figure 3).

Alfalfa suppresses weeds common in annual crops by shading or avoiding seed production with frequent cuttings. This leads to less herbicide use, benefiting other organisms in the microecosystem. In addition to arthropods, the alfalfa canopy hosts trillions of beneficial microbes. Belowground, microarthropods, earthworms, and microorganisms thrive in alfalfa fields contributing to soil health. Alfalfa's ability to fix atmospheric N<sub>2</sub> in symbiosis with *Sinorhizobia* and its association with arbuscular mycorrhizal fungal communities increases nutrient availability for alfalfa and the following crop in the rotation as well as for soil microarthropods and microorganisms. Alfalfa's rhizosphere (area surrounding roots) has trillions of microorganisms, 10-100 times more than in soil farther from the root. Biological activity in alfalfa's rhizosphere increases due to the release of nitrogen and carbon-rich exudates from the plant.

Why is increasing biodiversity of soil microorganisms important? Soil's biogeochemical process is driven by different groups of bacteria and fungi altering soil structure and promoting soil aggregation. This provides habitat for different functional groups of microorganisms ultimately responsible for overall soil health. Previous research has found cropping systems including alfalfa, a perennial, have significantly greater fungal and bacterial biomass, diversity index, and soil richness compared with cropping systems including annual crops. Efforts to integrate alfalfa into cropping systems in Midwestern states, as well as communicating to farmers the benefits of doing so,

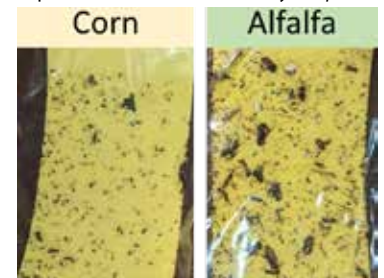
**Figure 1.** Pollinators visiting alfalfa flowers (Photos: Marisol Berti).



**Figure 2.** Soil pitfall traps and sticky traps (Photos: Anastasia Kurth).



**Figure 3.** Diversity of insects collected in sticky traps in corn and alfalfa (Photos: Haley Mosqueda).



are underway. Often farmers don't grow alfalfa because they do not have cattle, equipment required to cut/bale, or a market to sell the hay. However, there are creative ways to integrate alfalfa into cropping systems. For example, adding alfalfa to non- or low-productive headlands having poor corn or soybean yield can benefit wildlife and soil health. With many states under moderate to severe drought conditions, hay is valuable and in short supply and can provide extra income.

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