

Earth, Air, Fire, and Water: Extending the Queen's Realm.

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The Queen of Forages is great, but not perfect. Alfalfa's deep rooting habit and high potential for yield and symbiotic N₂ fixation help increase soil organic matter and the N supply to subsequent crops. Although alfalfa can fix large amounts of N symbiotically (8), it also absorbs N from the soil and reduces nitrate (NO₃) leaching (1). Thus, alfalfa can remediate NO₃-contaminated soils and water economically (9), and can utilize N from in-season manure applications. We have developed a field-based method to select alfalfa for higher or lower NO₃ uptake in pure stands (5), which should lead to cultivars with improved NO₃ uptake for remediation purposes and with poorer NO₃ uptake for use in mixtures with grasses. As alfalfa stands age, NO₃ can escape the root zone (1). Extending the vertical (7) and horizontal reach of alfalfa root systems and reducing mortality could help prevent these N losses. Alfalfa contributes all or most of the N required by a subsequent crop of corn (6), providing substantial economic benefits and energy savings in this crop rotation. Alfalfa mobilizes stored N to support shoot regrowth after harvest, drought, or winter. Can this period of dependence on internal N reserves be shortened through variety development? Retaining more N in root and crown tissue could accelerate soil organic N accumulation. Greater polyphenol content in alfalfa shoots and roots also could improve N cycling and farm profitability (2). Because of alfalfa's environmental and energy savings benefits, it should be adopted as a sustainable bioenergy crop for fuel and bioproduct production. Improved biomass germplasm and management systems have been developed that double ethanol yield (4). We estimate that an alfalfa-alfalfa-corn-corn rotation yields high net energy (3), but this requires establishment in the last corn crop to maximize alfalfa yields. With current traits and planned improvements, The Queen is ready, and increasingly able, to extend her realm.

Selected references

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