## Alfalfa N Credits to Second-Year Corn Larger Than Expected

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Ifalfa can provide substantial amounts of nitrogen (N) to the first crop that follows it. Recent field research on first-year corn following alfalfa confirms it is highly likely that grain yields will not improve with added fertilizer N, except on very sandy soils.

For this reason, guidelines for fertilizer N rates on first-year corn after alfalfa usually are markedly lower than for corn grown after corn. This difference is called the alfalfa 'N credit' or the 'fertilizer N replacement value.'

Despite decades of research and educational efforts about first-year alfalfa N credits to corn, surveys indicate many growers still hesitate to fully adopt them. Sometimes reluctance is attributed to the idea that extra fertilizer N is 'cheap insurance' against potential yield loss if the N credits are incorrect, or it may be a response to a grower experiencing an actual yield loss under a particular set of conditions. And, it may not help that Midwestern states do not share the same guidelines.

The disparity in N credits among Midwestern states for the second crop grown after alfalfa is even greater than that for the first crop grown after alfalfa. Iowa recommends growers apply less than 60 lb N/ac, which is an N credit of more than 100 lb/ac under most grain:fertilizer price ratios. Minnesota, North Dakota, and South Dakota, recommend an N credit of 75 lb N/ac for second-year corn after a good alfalfa stand, about one-half the N credit that was given in the first year. Illinois and Wisconsin recommend a smaller N credit (30-50 lb N/ac). And five states (Kansas, Michigan, Missouri, Nebraska, and Ohio) recommend taking no N credit, which means second-year corn should be fertilized at the same rate as continuous corn.

There is, of course, no biological reason for alfalfa N credits to differ among states within a region. Very few published studies are available on this topic, but an upcoming paper in *Agronomy Journal* will report new findings and compare them with other published work.

In 17 Iowa field trials conducted in 1989-1991 and in 11 Minnesota field trials in 2011-2012, the response to fertilizer N by the second consecutive crop of corn after alfalfa varied widely. **In about half of the cases, the second crop of corn showed no grain yield response to fertilizer N.** In the other cases, maximum yields were obtained with N rates ranging from 40-175 lb N/ac. Alfalfa stands were



between two and seven years old when terminated by tillage or herbicide and tillage. A data compilation from other published reports confirmed these results; probabilities for no fertilizer N response and for a wide range of economically optimum N rates at responsive sites were very similar to these newly reported field trials.

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As described earlier, there are many reports that the alfalfa N credit completely satisfies the need for N in the first year of corn production. In 20 of the 28 field trial sites in Iowa and Minnesota, the N response of first-year corn also was measured. In 11 cases (55%) corn grain yield did not increase with fertilizer N in either year. This is direct evidence that, **about half of the time, corn required no additional N to achieve economically optimum yields during the first two years after alfalfa**.

The flip side of this finding is that, for the other half of the cases, second-year corn needed additional fertilizer N for maximum economic returns. Is it possible to determine when that will occur? The short answer is 'no,' at least not yet.

The presidedress soil N test (PSNT), which is a good predictor of needing N in corn after corn and corn after soybeans, is a poor predictor of N response in this crop rotation. In about two-thirds of the cases, the PSNT accurately predicted when second-year corn would respond to fertilizer N, but it was incorrect more than 30% of the time. However, even when the PSNT correctly identifies a field that will respond to fertilizer N, it cannot reliably estimate the amount of fertilizer needed. Given that the optimum N rate could be anywhere between 40 and nearly 200 lb N/ac, the PSNT is not much help.

A recent innovation in predicting the economically optimum fertilizer N rate for first-year corn after alfalfa involves simple predictors: soil type (coarse, medium, or fine textured); alfalfa stand age at termination; time of termination (spring or fall, for medium textured soils only); and monthly weather conditions from October before corn is planted through spring. This system needs to be tested in new field trials, but a similar approach may work for second-year corn.