Satellite Images Reveal Patterns in Crop Rotations with Alfalfa

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After corn, soybean, and wheat, alfalfa is the fourth most widely grown and valuable field crop in the United States. During the past three years, nearly 18.7 million acres of alfalfa were grown annually across the country and this production was valued at $7.5 billion per year. In addition to its economic value, alfalfa provides many benefits to cropping systems.

Crops that follow alfalfa in rotation usually benefit from reduced nitrogen (N) requirement from fertilizer or manure, increased yield potential than when following other crops, and reduced weed, insect, and disease pressure. Recent research indicates that the first corn crop following alfalfa usually requires little or no N fertilizer, except on soils with high amounts of clay or sand, or on medium-textured soils when alfalfa is terminated in the spring. Fertilizer N response is more likely after young alfalfa stands (one or two years since seeding) than after older stands. Field trials also show second-year corn after alfalfa responds to added N fertilizer only 45% of the time.

Although benefits of alfalfa in crop rotations often depend on how long alfalfa is kept in production, limited data exist on this for the Upper Midwest, where about one-third of the nation's alfalfa is produced. Additionally, no data are available describing geographic patterns in which crops are grown after alfalfa.

The USDA-National Agricultural Statistics Service has used satellite images to create annual maps of crop types in a product called the Cropland Data Layer. Cropland Data Layers for 2006-2012 were combined to describe geographic trends in alfalfa production length and the two crops that follow alfalfa in six midwestern states.

Alfalfa Production Length

Shorter alfalfa stands (2-4 years, including the seeding year) were most frequent in northern and central Iowa, southeastern South Dakota, eastern Nebraska, and nearly everywhere south of Interstate 94 in Minnesota (Table 1). Longer stands (5-7+ years) were most frequent across the Dakotas (except near the Red River Valley and southeast South Dakota), in Nebraska, and in northern Minnesota. Wisconsin had several areas of both shorter (2-4 years) and longer (5-7+ years) alfalfa production lengths.

The trends in alfalfa production lengths may be related to climate. Growers in the drier areas of this region may be able to maintain alfalfa stands longer than in wetter areas due to the reduced likelihood of soil compaction and lower alfalfa disease pressure. Soil texture was also related to alfalfa production length. Soils with higher clay content usually had shorter alfalfa lengths, likely due to greater risk of soil compaction on these soils and possibly because of higher incidence of soil-borne alfalfa diseases.

First-Year Crops After Alfalfa

Corn was the most frequent first-year crop after alfalfa in all states except North Dakota (Table 2).

Soybean, which usually requires no N fertilizer, was the first-year crop in 15% of cases across the Dakotas, Minnesota, and Iowa, but was less prevalent in Nebraska and Wisconsin. These results indicate that a substantial number of growers in some states are underutilizing the alfalfa N credit by growing soybean as the first crop after alfalfa.

Small grains were the first-year crop most frequently in the Dakotas (one-third of rotated acres) followed by Minnesota and Nebraska. North Dakota had the highest frequency of minor crops (e.g., sunflower, sugarbeet, potato) as the first-year crop.

Second-Year Crops After Alfalfa

Corn was the second-year crop produced by one-half to three-fourths of growers in all states except North Dakota, where it was grown less frequently (Table 3).

Soybean was the second-year crop in 25-37% of cases across each state except Wisconsin, where soybean was only half as frequent. Because alfalfa can provide significant amounts of N to the second-year crop, utilizing the N credit by selecting a second-year crop that usually requires N from fertilizer or manure may enhance economic return.

Small grains were the second-year crop in less than 10% of cases in all states except North Dakota, where they comprised one-fourth of the second-year crop. North Dakota also had the highest frequency of minor crops as the second-year crop.

Alfalfa was the second-year crop in 5% of the cases across all states. Alfalfa as the second-year crop could lead to high nitrate losses if the N supply from the previous alfalfa phase continues to be high, unless the new stand is seeded with a companion crop that can rapidly utilize the mineralized N.

Implications

These are the first geographic estimates describing crop rotation patterns of alfalfa and annual crops in the Upper Midwest. Such descriptions should improve estimates of economic and environmental benefits of alfalfa in crop rotations, aid in planning of fertilizer need assessments for alfalfa and the crops that follow, and help focus the development of education and research on best crop rotation practices. It is apparent that more research is needed in this region to document the potential yield benefit and recovery of N from alfalfa in soybean, small grains, or other crops.

Table 1. Alfalfa stand lengths, including seeding year, during 2006-2012.

State	Stand Length (years)					
	2	3	4	5	6	7
	--------% of alfalfa acres--------					
IA	43	31	7	3	5	11
MN	25	24	13	3	6	29
ND	6	4	2	2	19	67
NE	15	16	14	6	21	28
SD	15	13	10	4	13	45
WI	19	27	21	5	7	21

Table 2. First-year crops after alfalfa during 2008-2012.

State	First-Year Crop After Alfalfa			
	Corn	Soybean	Small Grains	Minor Crops
	--------% of rotated acres--------			
IA	86	13	1	0
MN	75	14	10	1
ND	40	18	34	8
NE	80	7	11	2
SD	61	14	24	1
WI	92	3	4	1

Table 3. Second-year crops after alfalfa during 2009-2012.

State	Second-Year Crop After Alfalfa				
	Corn	Soybean	Small Grains	Minor Crops	Alfalfa
	--------% of rotated acres--------				
IA	65	30	2	0	3
MN	52	35	8	2	3
ND	30	27	26	9	8
NE	62	25	4	3	6
SD	51	37	8	1	3
WI	76	14	5	1	4