manage fallow to boost wheat protein

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WHEAT GROWERS in the semiarid central Great Plains have been able to stabilize production with the use of fallow and modern technology and equipment. But the protein content of that wheat has generally been less than the 11.5 percent level desired by millers and bakers.

Our research has determined that available nitrogen and water must have similar distribution patterns in the soil profile to produce wheat grain with high protein content. With natural conditions during fallow an average of 90 percent of the soil water storage occurs while only 45 percent of the nitrate has been moved into the soil.

We have been looking at the practices of different nitrogen application times during the 14-month fallow period to see if there are any changes that can be made to improve grain protein levels. We found that the time of fertilizer application influences the distribution of nitrates in the soil profile. While the nitrate distribution in the profile did not greatly influence grain yields, it did have significant effect on the protein content of the wheat grain.

The time involved was needed to nitrify the ammonia and to move the nitrates far enough into the soil so they would be available to the plant roots when they were taking up the deeper stored soil water. When the application was too close to planting time, we found most of the nitrates in the upper few inches of soil, which would be dry during a large part of the crop growth period and thus, unavailable to the wheat plants.

We found a significant difference in the type of soil involved. For fine sand soils the application did not need to be as far ahead of wheat planting time as it did for a silt loam soil. We got the greatest accumulation of nitrates at wheat seeding time at the 3-

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foot depth 1 year after the ammonia application to the silt loam soil and 3 months after the ammonia application to the fine sand soil.

On silt loam soil

Our application of anhydrous ammonia was sufficient to produce 50-bushel-per-acre wheat crop with a protein content of 13 percent or greater regardless of the application time. We found though, that the nitrate content of the soil at planting time was greater when the anhydrous ammonia was applied the summer after harvest than when the ammonia was applied during the summer just before the crop was planted.

The protein content of the wheat was also greatest when the ammonia was applied during the summer after harvest. Our soil tests showed the reason for this. There was a total of 45 pounds more nitrate per acre in the 3-, 4-, and 5-foot soil depths in each of the two after harvest application times than we found in the same soil depths of any other application time.

When the ammonia was applied in the summer after harvest there was plenty of time for late fall, winter, and spring precipitation to move the nitrates into the soil where they would be available when the crop roots were utilizing the deeper stored soil water. There was about as much nitrification of ammonia into nitrates at other application times, but much of it remained in the top foot of soil. And since the top foot of soil is dry during the greater part of the growing season, the nitrate in this soil is seldom available for uptake by the crop at a time when it will be used to increase the protein level.

On fine sand soil

We noticed greater differences in soil nitrate levels due to ammonia application times on the fine sand soil than we did on the silt loam soil. There were still, though, only small differences in the yielf of the grain. The protein content of the grain was not as directly related to the nitrate level of the soil as with the silt loam soil.

We saw the highest protein content when the ammonia was applied on June 15 (the crop was planted on September 15). But when the ammonia was applied on May 15, May 30, June 15, and June 30, the soil had an average of 40 pounds more nitrate in the 3-, 4-, and 5-foot levels than we found in the same depths of any other application time.

This shows, as one might expect, that with sandy soils the anhydrous ammonia does not have to be applied as early in the fallow period to get the nitrate down into the soil as on a silt loam soil. There was an indication that some nitrate leached below 6 feet in the sandy soil—the deepest we sampled—when the ammonia was applied in the summer after harvest.

For all of our tests we applied the anhydrous ammonia at the rate of 60 pounds of nitrogen per acre with a V-blade machine having 3 blades 5 feet wide and operated at a 4- to 6-inch depth. □

Soil nitrate content at seeding of winter wheat (Sept. 15) and subsequent grain yields and protein contents as affected by anhydrous ammonia application times during fallow on two soil types.

Application	Silt Loam			Fine Sand Loam		
Time*	Nitrate	Yield	Protein	Nitrate	Yield	Protein
	Lbs/A	BU/A	%	Lbs/A	Bu/A	%
No Application	77	41	11.7	46	28	10.7
July 20, 1st summer	124	49	14.1	82	35	13.0
Sept. 8, 1st summer	126*	54	14.5	70	39	12.5
May 15, 2nd summer	102	52	13.6	116	40	13.4
May 30, 2nd summer	111	49	13.9	91	41	13.6
June 15, 2nd summer	103	52	13.1	107**	43	13.8
June 30, 2nd summer	105	52	13.3	94	38	13.5
July 15, 2nd summer	118	52	13.6	97	43	13.1
July 30, 2nd summer	112	45	13.2	91	41	12.8
Aug. 15, 2nd summer	89	46	12.1	62	36	12.1

* First application (July 20) made at start of fallow, last application (Aug. 15) made near end of fallow, approximately 13 months after the first application

** Application date with greatest nitrate accumulation at 3-foot or deeper depth

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