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NITROGEN BOOSTS WHEAT PROTEIN AND WHEAT PROFITS

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Low protein wheat, harvested from the dryland area of southern Idaho, represents a staggering financial loss for growers. With 12 to 15 million bushels of wheat grown each year, the premium for the higher protein would mean around $3 million a year to Idaho farmers. Because of the low protein content, the use of Idaho wheat by the milling industry has been declining. Average protein has declined from a one-time high of 14-15% to a present-day low of 8-10%. Much of the red winter wheat must be sold as feed wheat. Nitrogen fertilizer and green manure crops are practical means of raising the protein of wheat to capture the higher price market.

Factors Affecting Protein in Wheat

Soil moisture is the main factor influencing wheat yield under our summer-fallow system of farming. However, **the amount of nitrogen available at a given soil moisture is the limiting factor as far as quality and wheat protein are concerned.** A 30-bushel wheat crop requires about 50 pounds of nitrogen to develop grain with 11% protein. Of the 50 pounds of nitrogen used, about 35 pounds will go into the grain and 15 pounds into straw. A 30-bushel wheat crop develops a 3600-pound straw crop **requiring 36 pounds of nitrogen to decompose the straw before any nitrogen is available for the next crop.** The protein content of a wheat crop will vary depending upon the yield as related to moisture and nitrogen present. The higher the amount of moisture present the higher the yield and the higher is the nitrogen requirement.

Climate and Soil

Climate is the most important single factor in determining the original nitrogen and organic matter levels of the soil. In its virgin condition, the soil ranged from a low of 1.5% organic matter in desert areas to 3.5% in the silt loam soils in the higher rainfall areas. During the summer-fallow season, organic matter decomposes and nitrogen is released. Formerly this provided sufficient nitrogen for both satisfactory yields and high protein grain. With continued cropping the organic matter has decreased to less than 1% in the lower rainfall areas, to 2% in the higher rainfall areas. The amount of nitrogen now released from decomposition of organic matter during a summer-fallow season, is 10-30 pounds. This is no longer sufficient for both high yields and high protein grain. With continued cropping last few years when we have received more than 14 inches of rainfall.

⇨ Your Alternatives ⇦

If the protein content of your wheat crop is in the 8% to 10% range, it is evident that your soil is low in nitrogen and something should be done. If nitrogen fertilizer is added, **about 40 pounds per acre will usually give a good response both in yield and percent protein.** If higher rates are desired they should be tried on small fields at first. In areas **where snow mold is a hazard the fertilizer should be applied broadcast over the wheat as early as possible in the spring.**

Nitrogen applied in the spring has more effect on protein content than nitrogen applied in the fall. **In areas over 5000 feet in elevation,** the September 1 seeding date should be used and the protein increased by a spring application of 40 pounds of nitrogen fertilizer. **In areas under 5000 feet,** seeding may be delayed until September 15, and 40 pounds of nitrogen applied either in the fall or spring.

When green manures are used sweet clover should be plowed down at a 16-18 inch height and the field then fallowed. If alfalfa is used, it should be plowed in the fall after the third season and the field fallowed the following year.

Variety of Wheat

There are small differences in the protein content of different wheat varieties. Protein content between the varieties has differed from year to year depending on the amount of moisture received during the growing season and the final

yield. Late maturing varieties respond differently to a wet or dry season than early maturing varieties. An average for the last three seasons for the more important varieties at the Tetonia Station follows:

Variety	Percent Protein*
Itana	13.1
Tendoy	13.4
Delmar	13.1
Cache	14.0
Cheyenne	12.7
Wanser	12.1
McCall	11.7
Itana 65	13.4

*40# of actual nitrogen applied each year to ensure high enough protein for quality studies.

The lower average protein content of the two new varieties, McCall and Wanser, was probably due to the higher yields obtained from these two varieties.

Rates and Dates of Seeding

The date of seeding, by affecting the yield, had an indirect effect on the percent protein at the Tetonia Station. Date of seeding caused nearly a 3% difference in protein as shown in the following table:

Date of Seeding	Percent Protein
August 15	9.8
September 1	9.1
September 15	10.1
October 1	12.4

Seeding early, from August 15 and September 1, produced heavy growth in the fall thereby using up more of the available nitrogen than the later seeding dates. However, to obtain maximum yields a good vigorous stand is required in the fall. The highest yields and lowest percent protein were obtained from wheat sown on September 1. The October 1 seeding provided the highest percent protein but also the lowest yields. The yields obtained from the October 1 seeding were equivalent to spring wheat.

The percent protein in the wheat kernel was related to the rates of seeding as shown in the following table:

Rate of Seeding Per Acre	Percent Protein
20 pounds	11.0
40 pounds	10.9
60 pounds	10.0
80 pounds	9.3

The higher the rate of seeding, the more vegetative growth and the lower the percent protein in the wheat kernel. This was not directly correlated to yield because the highest yields were obtained from the 40-pound seeding rate. As the seeding rate increased, more soil nitrogen went into developing straw which left less for producing protein in the wheat kernel.

Nitrogen Sources

Repeated trials at the Tetonia Station and off-station have shown that wheat protein can be increased by nitrogen fertilizer. The trials covered both dry and wet years. During a period of dry years, 1955 through 1962, 18 trials were conducted on the Rexburg Bench. In all trials ammonium nitrate fertilizer was applied on fall wheat in the early spring of the crop year. Definite response to nitrogen was found as shown in the following table:

Rate of Nitrogen Pounds actual/acre	Bu/A	% Protein
0	29.1	9.3
20	33.5	10.2
40	36.2	11.0
80	36.6	12.6

In 12 out of the 18 trials significant increases in yield were obtained. The 40-pound rate gave the highest economical response—7.1 bushels more than the check. The percent protein increased as the amount of nitrogen increased from 9.3% for the check to 12.6% for the 80-pound application. Generally nitrogen fertilizers do not increase the amount of protein very much until maximum yields have been reached.

During these same years, trials at the Station gave no significant yield increases but in every case gave an increase in protein. However, in the last three years there has been higher than normal rainfall and good yield response has been obtained at the Station from nitrogen fertilizer as shown in the following table:

Rate of Nitrogen Pounds actual/acre	Bu/A	% Protein
0	40.3	9.1
30	52.3	10.0
60	52.6	11.4
90	49.2	12.9

Significant increases in yield were obtained all three years. The 30-pound rate gave as large a yield response as the 60- or 90-pound rate. However, the percent protein continued to increase from 9.1% for the check to 12.9% for the 90-pound nitrogen rate. To obtain a desirable protein level, at least 60 pounds of nitrogen had to be applied.

Green Manures

Sweet clover or alfalfa as green manure is another way of adding nitrogen to the soil. Nitrate nitrogen in the summer-fallow has been increased from 25 pounds in the wheat-fallow to 80 to 100 pounds following these legume crops.

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