University of Idaho
College of Agriculture
Cooperative Extension Service
Agricultural Experiment Station

Current Information Series No. 223
April 1974

Wheat Straw Management And Nitrogen Fertilizer Requirements

J. H. Smith, M. J. LeBaron, C. L. Douglas

Straw and other crop residues may be an asset or a liability to the farmer depending upon how they are managed. If plant residues and straw are not managed properly, they may reduce water infiltration when layered at the plow sole, clog tillage implements and cause damage to crops during cultivation. Proper management of straw and other crop residues can maximize the benefits and minimize the disadvantages. This publication summarizes several years of research at Kimberly on straw management and nitrogen requirements of crops grown in association with straw residues.

Nitrogen Requirement for Straw Decomposition

Wheat straw grown in southern Idaho contains from 0.25 to 0.50 percent nitrogen. For most rapid decomposition, additional nitrogen must be available to supplement the low nitrogen content of the straw. With normal temperatures and adequate moisture, fertile agricultural soils will provide enough nitrogen from nitrification to meet the requirements for straw decomposition. Several experiments conducted at Kimberly have shown that adding fertilizer nitrogen to the straw did not accelerate straw decomposition. Of course, the soil nitrogen immobilized in straw decomposition may need to be replaced with fertilizer to provide adequate nitrogen for a crop grown after wheat straw is incorporated. A crop that requires little nitrogen or a nitrogen-fixing crop will not be influenced as much as a crop with a large nitrogen requirement.

To determine the amount of nitrogen needed to compensate for that immobilized by straw, you need first to determine the amount of straw incorporated. The amount of straw produced varies widely. There is very little direct relationship between grain and straw yields of irrigated grain.

One recent year, Lemhi wheat yielded 62 bushels of grain and 3.7 tons of straw per acre. The following year with 70 bushels of grain per acre only 2.3 tons of straw were grown. Nugaines wheat yields both more grain and more straw than Lemhi. In the same years reported for Lemhi, Nugaines yielded 96 bushels of grain and 6.7 tons of straw per acre the first year, and 120 bushels of grain and only 4.3 tons of straw per acre the next.

These straw yields were obtained by recovering all the straw. The amount of straw harvested and baled behind a combine and removed from the field usually represents only about 50 percent of the total. Loss of chaff and small pieces of straw and the inability of machinery to pick up the broken straw contribute to the rather low harvest recovery.

Straw Management

Straw is most beneficial in a crop rotation on irrigated land when the straw is well mixed with the soil and allowed to decompose.

Many farmers disc the straw lightly, allow germination of seed lost from harvest, and then plow it under as a green manure crop. Some disadvantages are associated with this practice. The main crop of straw does not have the maximum time for decomposition because much of it remains on the surface. The few pounds of additional organic matter obtained from the volunteer grain do not justify delaying plowing and decomposition of the straw. The lost wheat seed will be germinated with either discing or plowing and will not be a problem in the following crop if the straw is plowed under.

Best management practice is to plow the straw under as soon as possible following harvest, and irrigate as necessary for plowing and for rapid straw decomposition.

If the succeeding crop requires additional nitrogen fertilizer, fertilize in the spring. Nitrogen applied to straw at the time of fall plowing is used less efficiently by the following crop than nitrogen applied just before planting.

There are times when fall fertilizing with nitrogen may be justified. For example when nitrogen is in short supply, as it is now, fertilize with nitrogen whenever you can get it. If the straw is plowed in the early fall and nitrogen is applied late in the fall and disced into the soil, most of the benefits of spring fertilizing can be obtained.

There has been considerable speculation that Nugaines straw decomposes slower than other straw varieties. Many field observations have been made of straw residue plowed to the surface after it was buried in the soil for many months. This occurs more frequently with Nugaines than with other varieties, and it is probably because Nugaines produces much more straw. Our observations show that Nugaines straw decomposes faster than Lemhi straw.

Beans Following Wheat

Nitrogen is not recommended for beans following wheat. In one recent study, pinto beans were planted on plots that had grown either Lemhi or Nugaines wheat the previous year. Nitrogen was applied at rates of 77 pounds per acre. Yields of cleaned pinto beans averaged 22 cwt per acre following both wheat varieties either with or without nitrogen fertilizer. This experiment and other observations indicate that nitrogen fertilizer does not influence the yield of pinto beans in a wheat and beans rotation.

Sugarbeets and Wheat Straw

Sugarbeets grown following wheat showed a marked response to nitrogen fertilizer. Without sufficient nitrogen, the plants showed nitrogen deficiency symptoms and yielded poorly. With adequate nitrogen, the yields were excellent. When excess nitrogen is used, the sugar percentage in the beet will decrease. Nitrogen will also increase impurities and decrease recovery of sugar in processing the beets.

In one experiment, sugarbeets were grown following Nugaines wheat that had been fertilized with 100 pounds of nitrogen per acre. The treatments were various rates of straw and various levels of nitrogen applied in the fall or spring. The straw was plowed in either early September or mid-November. When nitrogen was applied on the straw in the fall and additional nitrogen in the spring, approximately 20 pounds nitrogen per ton of straw were required to compensate for nitrogen immobilized by the straw (Table 1). When nitrogen was applied in the spring approximately 15 pounds of nitrogen compensated for each ton of applied straw.

Spring fertilization in this case was more efficient than fall fertilization. We think that early fall plowing of the straw, keeping the soil moist to enhance decomposition, and late fall application of nitrogen would decrease the differences between these treatments somewhat and may be almost as efficient as spring fertilization in seasons when rainfall is not excessive.

Sugar percentages in the beets were high in all the treatments and were decreased only by the 180 pounds of nitrogen on plots that received no straw (Table 1). The high sugar percentages were probably brought about by cropping the previous year to wheat with moderate fertilization, which resulted in a low soil nitrate level. Sugar yields were influenced by both nitrogen fertilization and straw applications (Table 1). Sugar yields were increased by nitrogen fertilization to a point but because of decreasing sugar percentages with increasing nitrogen fertilizer the highest nitrogen application decreased yield of sugar in the absence of straw.

Table 1. Sugarbeet yields, sugar percentages and sugar yields as influenced by straw applications and nitrogen fertilizer.

N Fertilizer lbs/acre		Straw applications tons/acre		
Fall	Spring	0	3	6
		Sugarbeet yields (tons/acre)		
0	0	21.2	17.0	14.8
0	60	25.7	23.1	22.1
0	120	28.4	26.1	24.4
60	0	25.1	21.4	19.2
60	60	27.0	25.8	24.0
60	120	29.0	27.5	25.2
		Sugar percentage		
0	0	18.3	18.1	18.8
0	60	18.4	18.8	18.7
0	120	18.1	18.8	18.9
60	0	18.1	18.6	18.6
60	60	18.2	18.6	18.6
60	120	17.6	18.4	18.4
		Sugar yield - lbs/acre		
0	0	7,770	6,060	5,570
0	60	9,440	8,700	8,270
0	120	10,260	9,815	9,220
60	0	9,075	7,960	7,230
60	60	9,840	9,570	8,945
60	120	9,855	10,110	9,280

Early September compared to mid-November plowing dates produced some differences. The September plowing date produced beets with 18.6 percent sugar compared with 18.2 percent sugar and slightly lower total yield of sugar for the November plowing date. Sugarbeet yields were not significantly influenced by plowing dates but the appearance of the tops was considerably better for the early plowing than for the late plowing. This could cause some concern in observing the growth of the sugarbeet crop but did not produce material differences at harvest time except in sugar content.

Fertility practices that will produce low nitrate and high sugar percentage in the beet at harvest time are desirable. If residual nitrate levels are high following some crops, growing wheat on the land without excess nitrogen fertilization will decrease the soil nitrate content. When residual nitrogen is extremely high, more than one year of cropping to wheat will be required to remove the excess nitrogen. A soil test to determine residual nitrogen and an estimate of the straw incorporated will help you fertilize at a rate to obtain high yields and high sugar content of the sugarbeets.

Other Crops in Rotation with Wheat

When other crops such as potatoes are grown in rotation with wheat, similar factors can be used to compensate for the added straw. Approximately 15 pounds nitrogen in the spring or 20 pounds nitrogen on the straw for each ton of straw should be added to compensate for the straw and then the recommended amount of nitrogen fertilizer should be applied for the crop being grown. Leguminous crops, which fix some of their own nitrogen, may not need nitrogen to compensate for the added straw.

Recommendations

1. **Plow straw into the soil immediately after grain harvest, irrigating as necessary for plowing and for rapid straw decomposition.**
2. **When growing sugarbeets or other high-nitrogen-requiring crops following wheat, apply 15 pounds of nitrogen in the spring or 20 pounds of nitrogen in the fall to compensate for nitrogen immobilized in straw decomposition.**
3. **Compensate for nitrogen immobilization when necessary, then fertilize the following crop according to the best recommendations.**
4. **Nitrogen is becoming scarce and expensive. Use it efficiently by fertilizing according to crop requirements rather than for straw decomposition.**

* This research is discussed more completely in: Smith, J. H., C. L. Douglas, and M. J. LeBaron. 1973. Influence of straw application rates, plowing dates, and nitrogen applications on yield and chemical composition of sugarbeets. Agron. J. 65:797-800.

This information is published by the College of Agriculture Agricultural Experiment Station in cooperation with the Western Region, Agricultural Research Service, USDA.

The authors

— J. H. Smith is Soil Scientist, Snake River Conservation Research Center, USDA-ARS, Kimberly; M. J. LeBaron is Research Professor and Superintendent, University of Idaho Research and Extension Center, Kimberly, and C. L. Douglas is Soil Scientist, USDA-ARS, formerly at Kimberly and now located at Corvallis, Ore.

Published and Distributed in Furtherance of the Acts of May 8 and June 30, 1914, by the University of Idaho Cooperative Extension Service, James L. Graves, Director; and the U.S. Department of Agriculture, Cooperating.

4M 4-74