INFLUENCE OF NITROGEN FERTILIZER RATE AND TIMING ON PERFORMANCE OF TWO IRRIGATED HARD RED SPRING WHEAT VARIETIES

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ABSTRACT

In 1986 trials, for 30 to 40 units of total nitrogen available before planting, increasing yields and protein contents were obtained for increasing preplant fertilizer applications from 150 to 200 pounds nitrogen/acre. Increasing later fertilization from 30 to 50 pounds/acre of nitrogen at either boot to flowering increased protein content but not yield. Nitrogen added between tillering and boot was divided in its effect. These studies and similar ones from 1985 may provide guidelines for central Oregon growers to optimize economic returns. Our studies confirm others that the timing of the final addition of nitrogen is important, because when added from tillering to boot the nitrogen is used by the plant to increase yield and to a lesser degree protein content of the grain. From the boot stage to the flowering stage there is little to no contribution to yield but a large contribution to protein. Of the two varieties used, Yecora Rojo showed a distinct advantage over 906R in yield, test weight, and lodging in this trial, but there were no differences between the two varieties in protein content.

Central Oregon irrigated wheat growers are attracted to the higher selling prices for high protein hard red spring wheats. In 1986, 5,000-7,000 acres of hard red spring wheat were produced in central Oregon. According to one of the central Oregon seed companies, average protein from producers' fields ran slightly more than 15 percent, with some fields exceeding 16 percent. Although these figures reveal strides have been made in predictably producing high protein hard red spring wheat in central Oregon, the hard red spring wheat elite variety trial reveals that improved varieties are in the wings to improve yields while maintaining quality (see "Varietal Evaluation of Irrigated Cereal Grains in Central Oregon" in this publication). The work begun in 1985 in establishing optimum levels of pre-planting fertility and post planting fertility was refined in 1986 as follows.

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METHODS

The hard red spring wheat (HRSW) varieties Yecora Rojo and Westbred 906R were selected as the most widely grown varieties in central Oregon.

Preplant and in-season fertilization of 906R and Yecora Rojo included three replant rates of nitrogen at 150, 175, and 200 units of nitrogen per acre and two in-season rates of 30 and 50 pounds/acre of nitrogen applied at three different stages of plant growth. There were 42 treatments overall, replicated four times in a randomized complete block experimental design. The first 150 pounds nitrogen/acre of preplant nitrogen was as 27-12-0-11 (N-P-K-S) mechanically broadcast over the entire area of the experiment.

If applied, the additional 25 or 50 pounds/acre nitrogen was in the form of ammonium nitrate applied by hand over the entire five-foot x 20-foot plot area at planting time. In-season fertilization was with ammonium nitrate 34-0-0-0 (N-P-K-S) sprinkled over the plots by hand and irrigated into the soil. In-season fertilization was at 30 or 50 pounds/acre nitrogen applied at tillering (Feeks scale 4), at boot (Feeks scale 9), and at flowering (Feeks scale 10.51). The application dates were May 23, 1986, for tillering, June 9, 1986, for boot, and June 23, 1986, for flowering. Residual total nitrogen was at 30-40 pounds throughout the area of the plots. The previous crop was winter wheat but the ground had been fallowed for two years before planting.

Plots were planted and harvested using a standard plot drill and a Hege plot combine, with a drill row spacing of eight inches. The seeding rate was 100 pounds/acre for each variety. The planting date was April 4, 1986. Plots were first irrigated May 8, 1986, and the final irrigation was on July 23, 1986. Harvest was on August 24, 1986.

RESULTS

Significant differences between treatments are apparent from the overall results of the trial shown in Table 1. The specific differences are shown in Tables 2 through 5.

Table 1. Yield and protein content of two hard red spring wheat varieties under different fertility regimes at Madras in 1986

Preplant nitrogen	In-season fertility	Yield	Protein
lbs/acre		bu/ac	%
150	0	84.9	12.5
175	"	91.8	12.9
200	"	96.6	13.5
150	30 N tillering	95.3	13.0
175	"	97.1	13.6
200	"	96.9	14.0
150	50 N tillering	93.7	13.5
175	"	97.7	13.9
200	"	100.3	14.0
150	30 N boot	91.8	13.2
175	"	95.6	13.6
200	"	93.5	14.1
150	50 N boot	92.6	13.9
175	"	92.9	14.2
200	"	98.6	14.4
150	30 N flowering	86.7	13.5
175	"	96.9	13.9
200	"	96.4	14.0
150	50 N flowering	91.7	13.7
175	"	94.0	14.2
200	"	97.4	14.2
LSD (5%)		5.88	.30

The data indicate several principles that should be most helpful to the growers in this area:

1. The best preplant fertilizer rate is from 175 to 200 units of nitrogen, when soil tests show 30-40 units of total nitrogen as residual nitrogen in the soil (Table 2.)
2. Additional fertilization is necessary to gain the desired protein levels. This can be added anywhere from boot to flowering and gain the desired effect (Table 3).
3. 50 units of nitrogen added from boot to flowering is better than 30 units of nitrogen (Table 4).
4. In-season nitrogen has to be added after boot to have the greatest impact on protein, because before this stage of development the plant will use the nitrogen to enhance yield with less of a positive effect on protein (Tables 1 and 3).

Table 2. Yield and protein content for two hard red spring wheat varieties at three fertility levels at planting

Preplant nitrogen lbs/acre	Yield bu/acre	Protein %
150	90.9	13.3
175	95.1	13.8
200	97.1	14.0
LSD (5%)	2.2	.1

Table 3. Yield and protein content for two hard red spring wheat varieties at two levels of fertility and at three stages of plant development

Postplant nitrogen lbs/acre	Yield bu/acre	Protein %
0	91.1	13.0
30 at tillering	96.5	13.5
50 at tillering	97.2	13.8
30 at boot	93.6	13.6
50 at boot	94.7	14.2
30 at flowering	93.3	13.7
50 at flowering	94.4	14.0
LSD (5%)	3.4	.2

Table 4. Yield and protein content of two hard red spring wheat varieties at three levels of fertility after planting

Postplant nitrogen lbs/acre	Yield bu/acre	Protein %
0	91.1	13.0
30	94.5	13.6
50	95.4	14.0
LSD (5%) for "0" vrs others	2.59	.13
LSD (5%) for "30" vrs "50"	NS*	.1

* NS = not significant

Varietal differences were apparent in this trial as Yecora Rojo performed significantly better than 906R in yield, test weight and lodging, with no difference in protein in this growing season and test (Table 5).

Table 5. Yield, test weight, lodging and protein content of two hard red spring wheat varieties

Variety	Yield	Test weight	Lodging	Protein
	bu/a	lbs/bu	%	%
906R	88.5	62.6	25.8	13.7
Yecora Rojo	100.3	63.9	3.6	13.7
LSD (5%)	1.8	.1	6.3	.1

DISCUSSION

In 1986, results reported above, 170-200 pounds/acre preplant nitrogen with 50 pounds/acre nitrogen added from boot to flowering provided greatest yield, good test weights, and greatest increase in protein in the two hard red spring wheat varieties tested. Levels of preplant nitrogen higher than 200 pounds/acre were not utilized.

In our 1986 Cerone trial (see "Effect of Cerone anti-lodging agent and nitrogen fertilizer rates on performance of two irrigated hard red spring wheat varieties", in this issue) we preplant fertilized at even higher levels of 225 and 300 pounds/acre of nitrogen in a deliberate attempt to induce lodging. We did not affect lodging, but results indicate yield and protein content responses leveled off at between 225 and 300 pounds/acre preplant nitrogen.

In 1985, (see "Influence of fertilizer rate and timing on yield, test weight, and protein content of three irrigated hard red spring varieties", Irrigated Crops Research in Central Oregon - 1986, pp 28-34), we found that 200 pounds/acre preplant of nitrogen was distinctly more effective than 100 pounds/acre preplant for increasing protein and yield, and that protein content continued to increase with later additional fertilizer applications even as high as 120 pounds/acre of nitrogen.

The primary reason for producing hard red spring wheats is the added return from higher protein content, which may vary from year to year in a region. Our 1985 and 1986 data may be sufficient to develop an economic analysis incorporating test weight and protein content (both factors which affect the

price of hard red spring wheat), yield, fertilizer costs, and application costs. We tentatively suggest that greatest economic return from production of available hard red spring wheat would result from:

a. 200-225 pounds/acre of nitrogen as preplant (when residual nitrogen is 30-40 pounds/acre)

and b. 40-50 pounds/acre of nitrogen added between boot and flowering