elevation model (DEM) were incorporated into the model to represent slope, aspect and soil wetness. Major soils found were Spodosols, Andisols, and Inceptisols.

Part 5. Economics and Sustainability

Protein Premiums can Motivate Nitrogen Fertilization of HRSW Beyond Maximum Yield

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The price that a producer receives for hard red spring wheat (HRSW), unlike soft white wheat (SWW), is influenced by protein content (%). The producer receives a price premium on HRSW with greater that 14% grain protein and a discount with less that 14% grain protein. Since both yield and protein percentage directly effect profit, producers may desire to apply levels of Nitrogen (N) fertilizer to HRSW that maximize profits considering both yield and protein. This research extends earlier work to determine weather protein premiums may motivate growers to apply N beyond maximum total yield response, which economists refer to as “stage three” of production.

The objective of this research was to determine economically optimal nitrogen fertilization of HRSW for varying protein pricing structures and to discuss factors which motivate profitable fertilization beyond maximum total product or “stage three” of production. Quality based adjustments in competitive output prices are common in agriculture, but their influence on incentives for profitable production into stage three appears not to have been discussed in previous research. For the southeastern Washington HRSW data used in this study, profit was maximized in stage three whenever the premium/discount for protein relative to the 14% protein base price equaled or exceeded $0.04/$0.06 per bushel per 0.25% protein deviations. This premium/discount threshold held for all wheat and nitrogen price combinations examined. At the highest premium/discounts examined, up to 33 lb/ac additional nitrogen beyond maximum yield was applied to capture profitable protein quality premiums. At high premium/discount incentives, the combination of low wheat price and low input price pushed production furthest into stage three, because quality premiums accounted for a greater proportion of total returns. In general, as the proportion of net returns from quality adjustments increases, the incentive to produce into stage three increases.

Economics of No-Till Annual Cropping Systems, Ritzville, WA

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From 1997-2004, William Schillinger conducted a no-till annual spring cropping system experiment in Adams County, near Ritzville, WA. The objective of this study was to determine the long-run economic and agronomic feasibility of no-till cropping systems for low-precipitation areas of the inland Pacific Northwest. The last four years of the study had six rotations involving crops of soft white spring wheat (SWSW), hard white spring wheat (HWSW), spring barley (SB), yellow mustard (YM), and soft white winter wheat (SWWW). The six rotations were: four-year SWWW/SWWW/SWSW/SWSW, four-year SWWW/SB/YM/SWSW, two-year SWSW/SB, two-year HWSW/SB, continuous SWSW, and continuous HWSW. The two-year SWSW/SB rotation and the continuous SWSW rotation were the only two rotations maintained throughout the entire eight-year project period. Conventional tillage soft white winter wheat-summer fallow (SWWW-SF was not included in the experiment. An economic comparison of this traditional system to the experiment’s no-till annual cropping rotations was accomplished by conducting a multi-year yield survey among neighboring SWWW-SF farmers. Comparative yield results for SWWW-fallow on neighboring farms are reported in a separate paper in this section.

None of the rotations were able to generate sufficient market returns to cover total costs during the relatively dry 2001-2004 period. Five of the six rotations earned statistically equivalent returns over total costs. The HWSW/SB, SWSW/SB, and SWSW rotations all had average annual losses of about $58 per rotational acre. The HWSW/SB rotation was the most risky in terms of profit variability with a standard deviation of $18.59/acre. Average returns of the surveyed SWWW-SF rotation considerably exceeded all of the experiment's no-till annual rotations at this site. Average returns over variable costs and total costs for the SWWW-SF rotation were $40.09 and -$9.99 per rotational acre, respectively, during 2001-2004. The S.D. of returns over total cost per rotational acre of SWWW-SF was $9.58. The poor returns over total costs can largely be attributed to yields reduced by diminished precipitation in the last four years of the experiment.

Comparing the 2001-2004 results to previously reported 1997-2000 results showed that costs remained relatively constant over the entire eight-year period. However, net returns over total costs for continuous SWSW fell from $17.92/acre for 1997-2000 to -$58.79 in 2001-2004.The corresponding comparison for continuous SWSW/SB is $8.12/acre versus -$58.13. When returns over total costs are averaged over the eight-year experiment period, the continuous SWSW and the SWSW/SB rotations generated returns of -$20.42/acre and -$25.01/acre, respectively. SWWW-SF averaged net returns over total costs of $2.35/acre over 1997-2004, roughly a $25/acre/yr long term advantage over the two no-till SWSW rotations.

Statistical Response of HRSW Yield and Protein to Nitrogen Fertilization: A Progress Report

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Recommendations regarding profitable input applications are vulnerable to misspecification of both quality and yield response functions. Response functions most commonly fitted in empirical work are the quadratic (for yield) and linear (for protein). While the quadratic yield functions impose diminishing yield response after a maximum, they preclude a plateau at the maximum that is supported by some agronomic theory and data. An examination of scatters of some of our data for hard red spring wheat response to N also suggests a yield plateau (see Figures 1 and 2). Others hypothesize that increased levels of applied N beyond the onset of the yield maximum will result in higher grain protein while grain yield is constant. The existence and length of this yield maximum plateau depends on site-specific factors such as the level of residual nitrogen. An innovation our ongoing research is to represent eventually decreasing yield in response to excessive fertilizer.

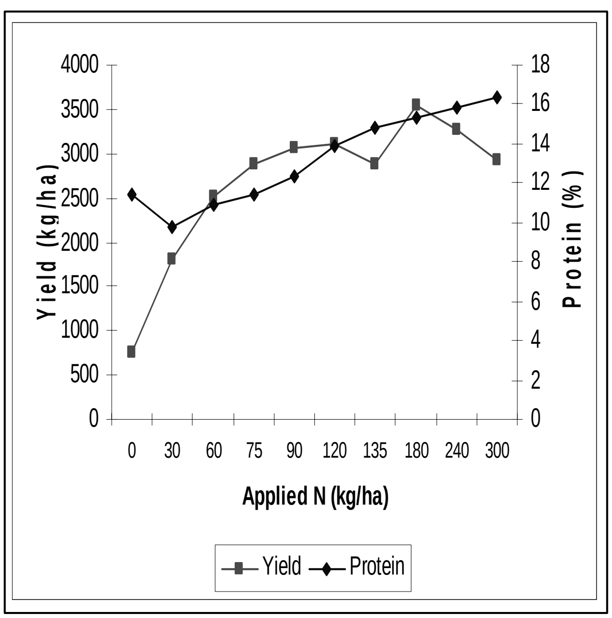

Fig. 1: Yield and protein responses to applied N, Bow Island, Alberta, 1998.

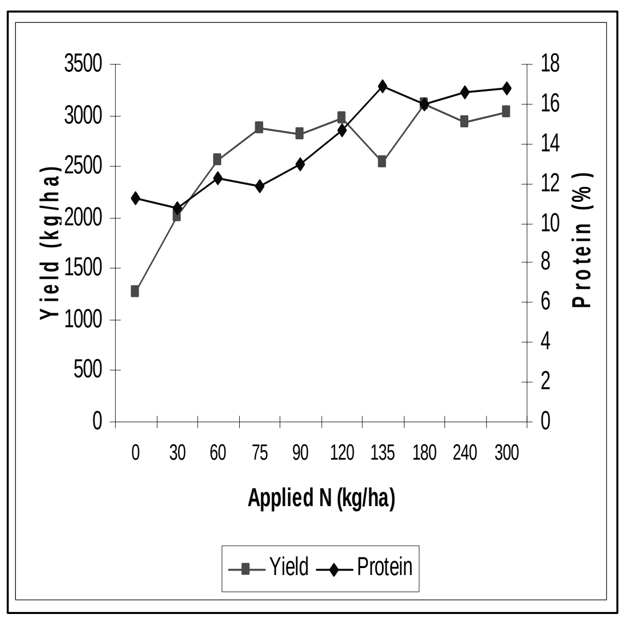

Fig. 2: Yield and protein responses to applied N, Bow Island, Alberta, 1999

In this research, a quadratic function with a stochastic plateau is considered. Using data from eastern Washington, USA and southern Alberta, Canada, optimal N levels and the expected plateau yield will be estimated statistically.