THE EFFECT OF PROTEIN GRADING ON N FERTILIZER ECONOMICS

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Introduction

The effect of various environmental and management factors on the protein content of milling grades of wheat has been the subject of considerable study. Sloman (1971) lists 103 references all dealing with management and environmental effects on wheat protein; a large portion of these references relate to nitrogen fertilizer or general soil fertility levels with respect to nitrogen.

It has been reasonably well established that nitrogen fertilizer will increase the protein content of wheat if the yield curve has reached a peak or if the slope of that curve is depressed by moisture stress or other factors (Henry, 1971). The numerous studies on this matter all lead to the same conclusion when they are placed on a similar base with respect to soil nitrogen levels and degree of moisture stress.

In recent years concern has been expressed about an apparent reduction in the average protein content of Canadian wheat. It now appears that there may be some problem in obtaining sufficient quantities of high protein wheat to meet Canada's committment in the world market place for this type of product. The current question is, therefore the requirement for protein premiums to provide incentive for farmers to produce more wheat of higher protein content and the form that these premiums might take, if implemented.

The purpose of this paper is to present some preliminary findings on the effect of various hypothetical protein grading systems on nitrogen fertilizer and overall farm economics.

Methods

For the purpose of studying the effect of protein grading systems, a contemporary source of data from one particular experimental location was utilized.

The experimental data is drawn from a project conducted in 1977 on an Elstow loam soil in the Outlook area of Saskatchewan. The level of available nitrogen was 35 lbs N per acre to 2 feet.

A range of water management treatments was a part of this study (Table 1). Irrigation scheduling had been implemented by utilizing tensiometers and irrigating when a soil moisture tension of 0.5 atmospheres was reached.

The data utilized herein were part of a larger study in which the response of various wheat cultivars (hard red spring wheat, utility wheat and soft white spring wheat) to water and nitrogen was being studied. The data for the hard red spring wheat variety

Sinton was utilized for this analysis.

The yield and protein data for Sinton wheat under the conditions studied are presented in Figures 1 and 2 respectively. These field data correspond almost exactly to theoretical concepts and other research data.

To examine the effect of protein grading on economic aspects it was necessary to make certain assumptions about systems that might occur in the future. As a base level, a price of $3.00 per bushel for wheat was assumed under a system of no protein grading. It was further assumed that 13.5% protein (based on 13.5% moisture) might be a base level for setting price and that price deductions below that point and premiums above that point might be implemented.

Premium levels assumed were $0.10, $0.20 or $0.30 per bushel per percentage point of protein. For the purpose of calculating a smooth curve type of production function, a price differential of $0.01, $0.02 and $0.03 per bushel per 0.1 percentage point protein was assumed. It is recognized that in actual practice this level of separation would not be implemented and is likely even beyond the capability of most measuring systems. However, for the purpose of calculation and demonstrating the effect of economics this was considered to be valid.

Results and Conclusions

The effect of various protein premiums on nitrogen fertilizer economics for the various levels of water management are presented in Figures 3, 4 and 5.

These data show clearly the very marked effect of various levels of protein premium on nitrogen fertilizer economics and on overall gross returns.

The actual change in optimum nitrogen fertilizer rate (Table 2) is very large under some systems. For example, for the water B treatment and for the assumption that the objective is a ratio of marginal return to marginal cost of 1.5 the optimum rate of nitrogen was approximately doubled in moving from no protein premium to one in which the premium was $0.30 per bushel per percentage point protein. In this paper no attempt is made to determine what levels of protein premium may exist in the future.

The economic data, as well as the data on actual percentage protein (Figure 2) show clearly that a graduated scale system of protein grading will be the only one in which any significant incentive for production of higher protein will occur.

With the strong effect of water management (or under dryland conditions - precipitation) it would be difficult if not impossible, to make nitrogen fertilizer recommendations to farmers for the purpose of reaching a specific protein level. For example, from Figure 2, if the objective was to produce 14% protein wheat then this would require less than 25 lbs N per acre under dryland but approximately 150 lbs N per acre under the water C treatment.

Under a graduated scale system it would be quite feasible to provide nitrogen fertilizer recommendations that would, with good probability, increase protein content by about 1 percentage point. Therefore, in the graduated scale system of protein grading such incentives would be real and the probability of economic return would be high.

References

1. Henry, J. L., 1971. Crop protein as related to soil, climate and production. Sask. Farm Sci. 18: No. 1: 1-3.

2. Sloman, D., 1971. Some factors affecting the protein content of cereal grain. B.S.A. Thesis, Dept. of Soil Science, University of Sask., Saskatoon, Sask.

Table 1. Water treatments utilized in 1977 study.

Treatment Name	Water Schedule
Dryland	Natural rainfall
Water A	Missed first irrigation
Water B	Missed second irrigation
Water C	Full irrigation

Table 2. The effect of protein premiums on the economics of N fertilizer use

	I*	II	III	IV
	N rate to optimize profit (lbs N/acre) with MR/MC** = 1.5			
Water A	40	60	65	70
Water B	85	95	155	165
Water C	135	140	150	180
	N rate to optimize profile (lbs N/acre) with MR/MC = 1.0 (graphical solution)			
Water A	35	70	100	110
Water B	75	100	150	200
Water C	100	130	180	200+

I = $3.00/bus straight price.

II = $0.10 premium or deduction per bushel per percentage point above or below 13.5% protein.

III = $0.20 premium or deduction per bushel per percentage point above or below 13.5% protein.

IV = $0.30 premium or deduction per bushel per percentage point above or below 13.5% protein.

MR/MC** = marginal return/marginal cost, N cost was taken at $0.20 per lb.

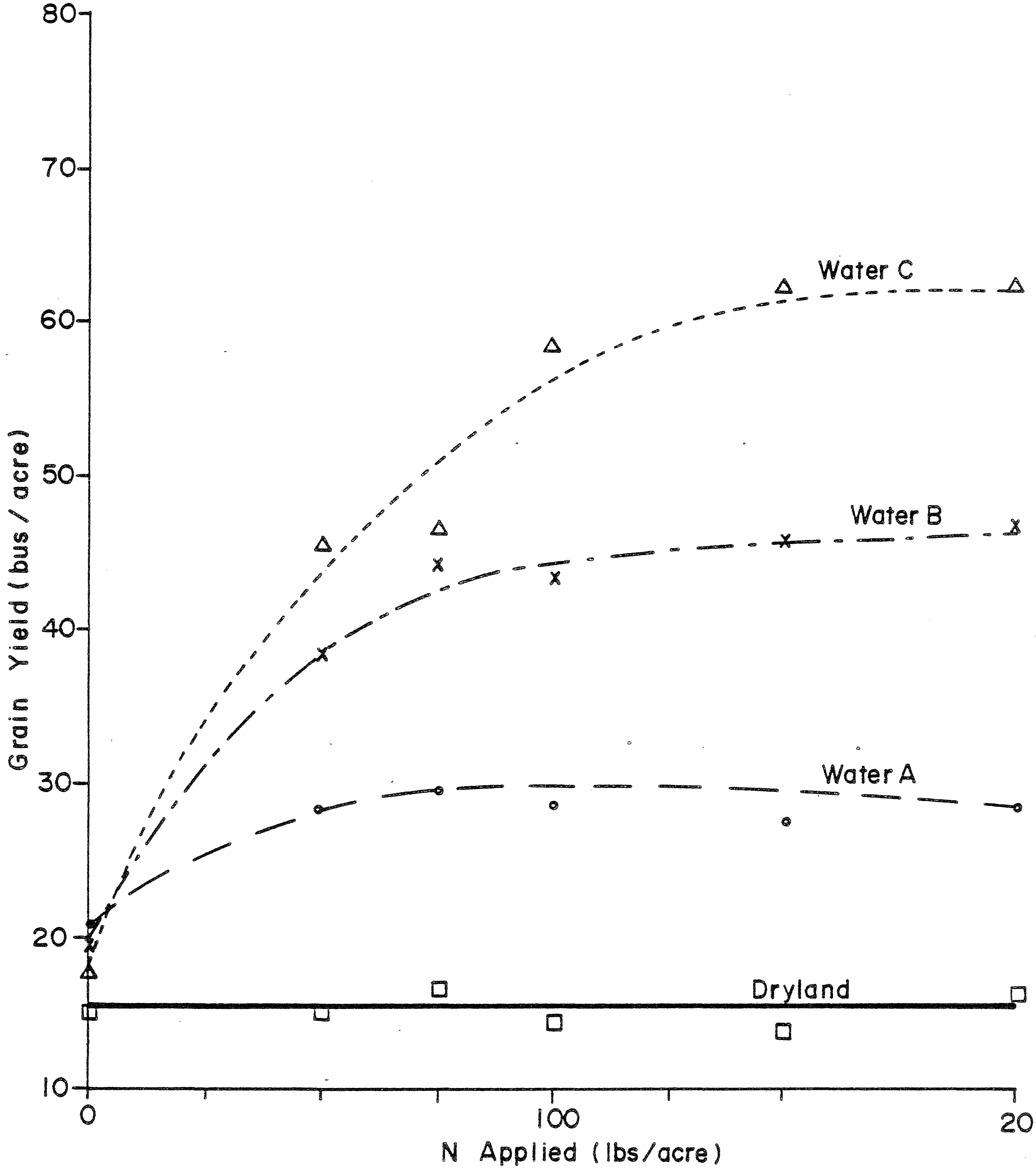

Figure I. The effect of N fertilizer and water management on the yield of Sinton wheat (1977) See Table I for explanation of water treatments.

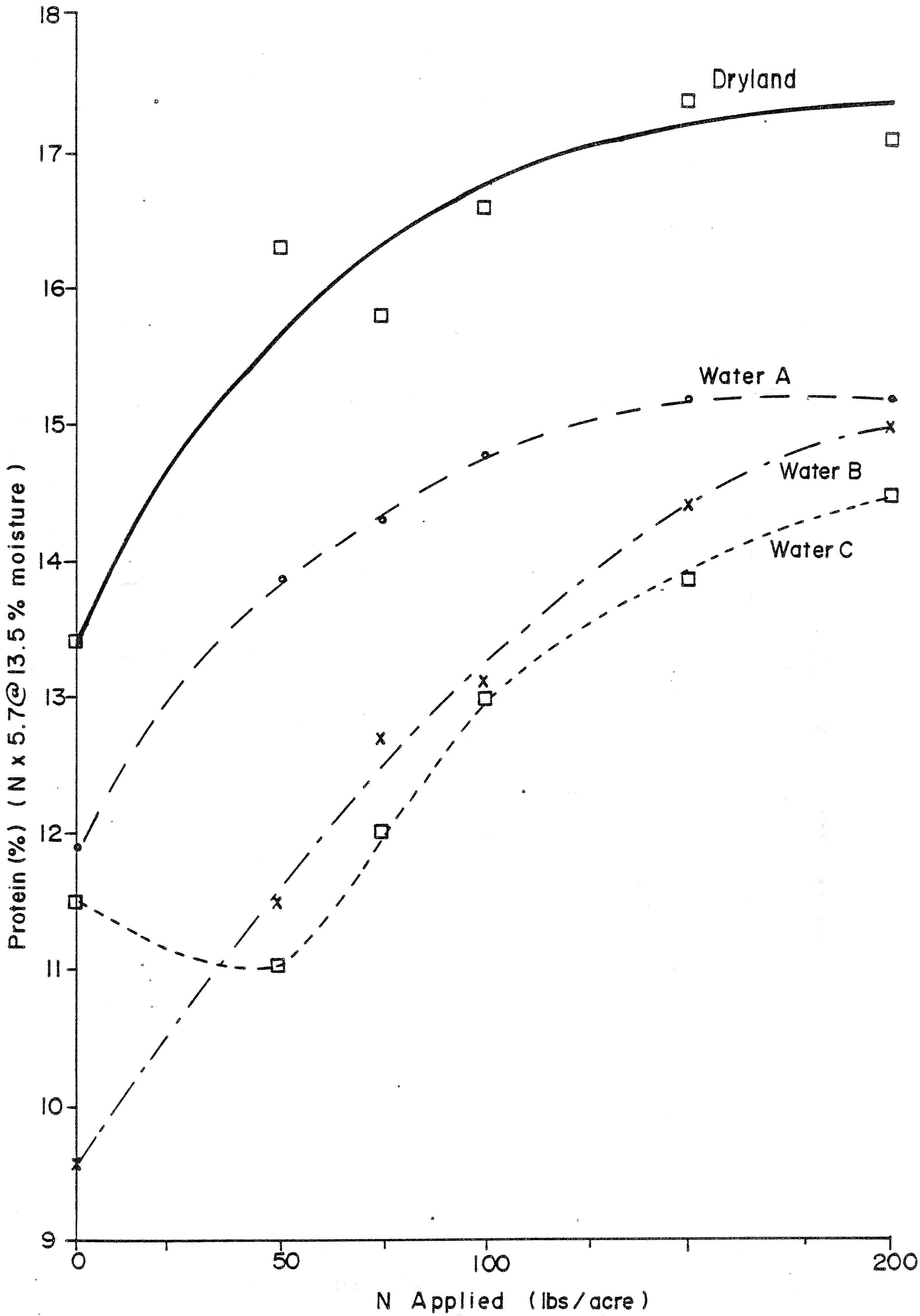

Figure 2 The effect of N fertilizer and water management on the protein content of Sinton wheat (1977) See Table I for explanation of water treatments

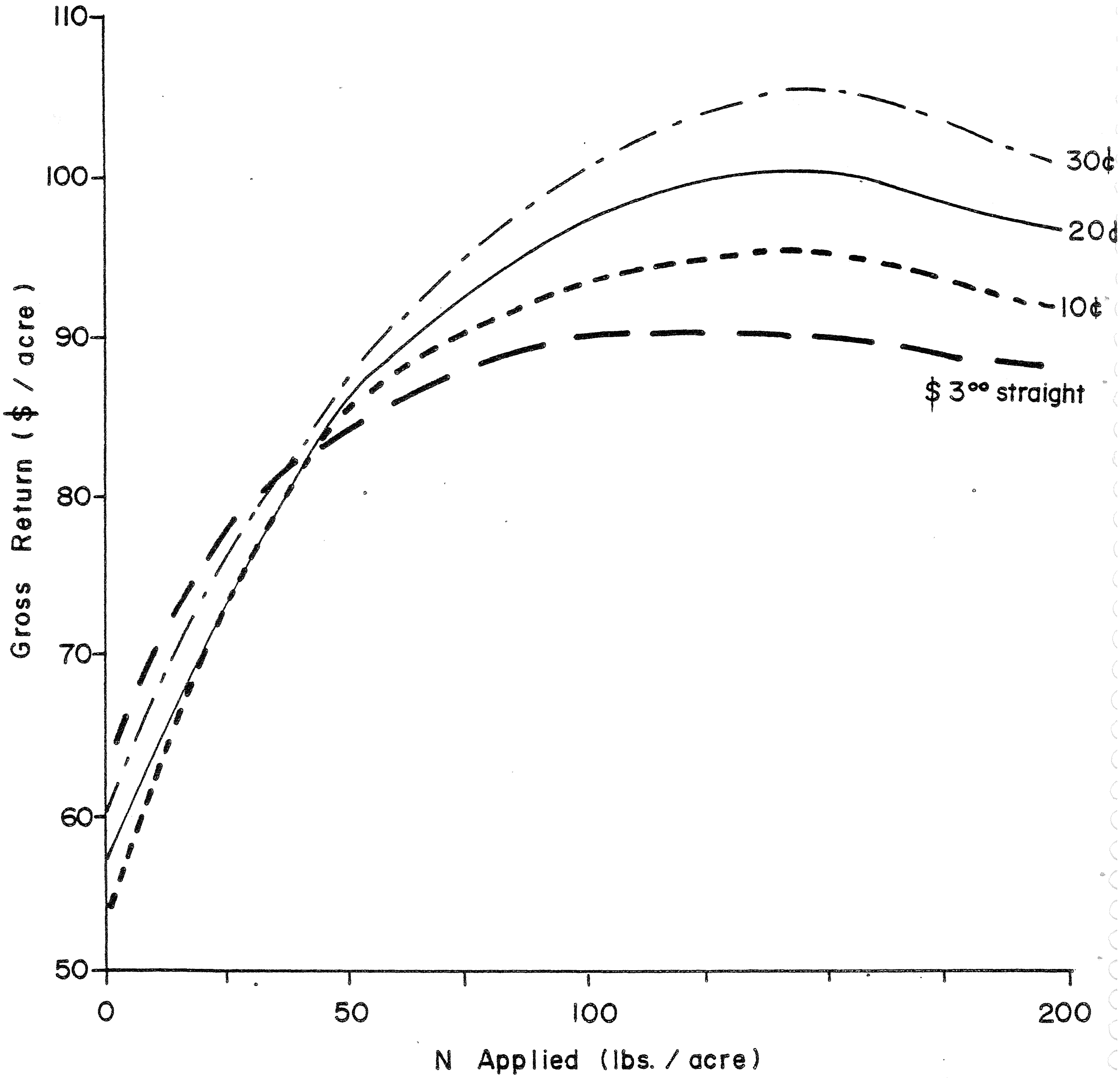

Figure 3 The effect of protein premiums on nitrogen fertilizer economics (Water A treatment from Figures 1 & 2) See Table 2 for explanation of protein premium price assumptions.

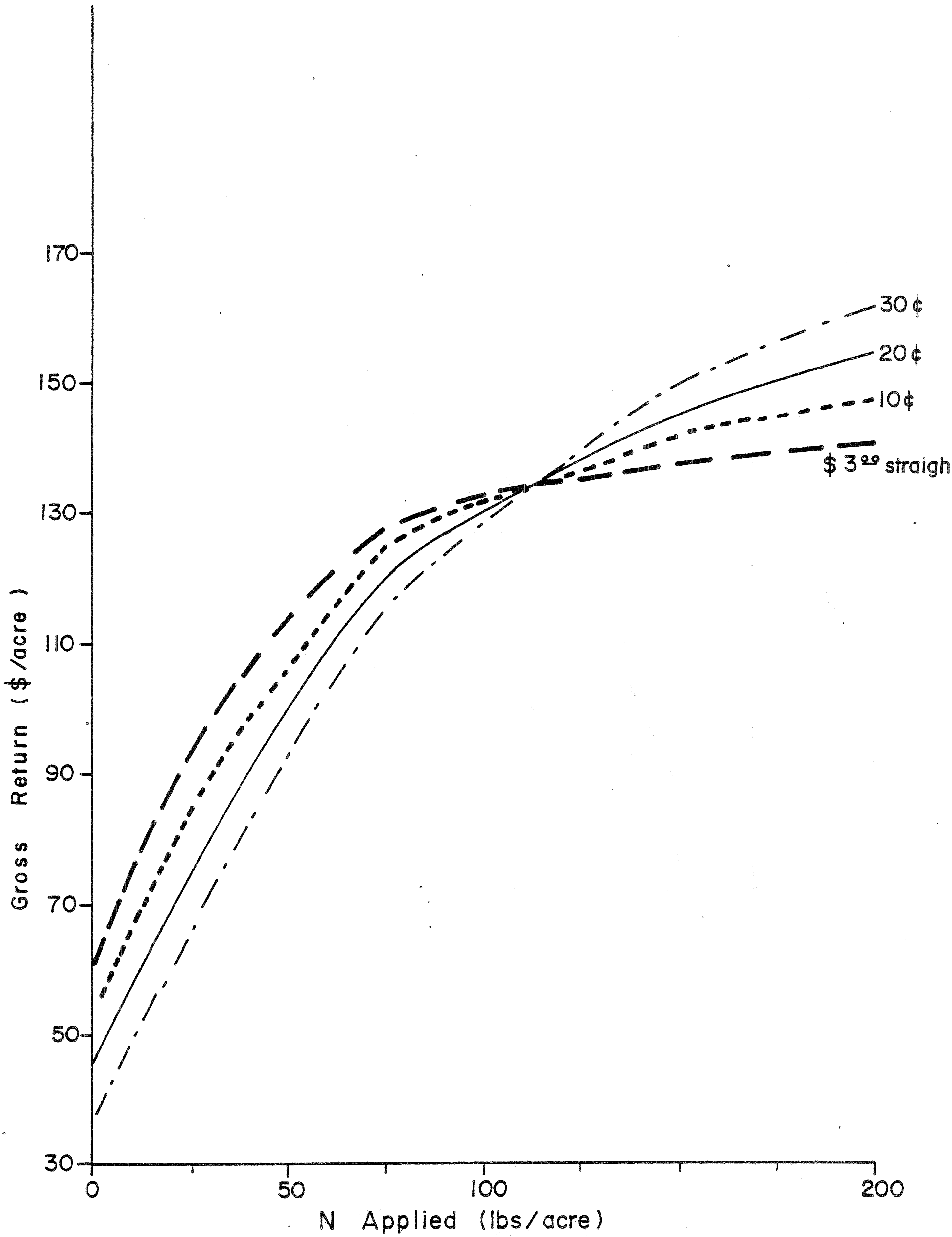

Figure 4. The effect of protein premiums on nitrogen fertilizer economics

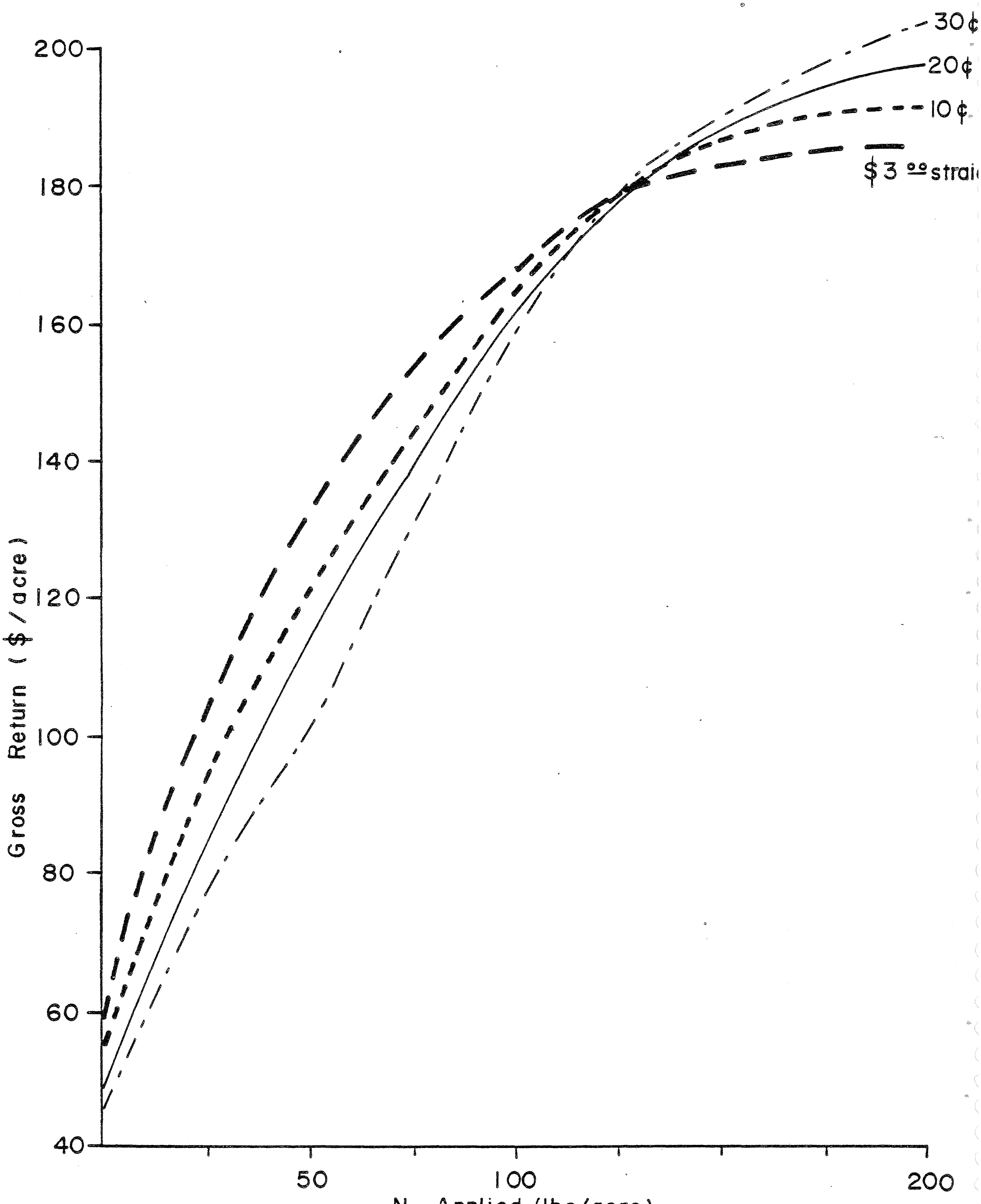

Figure 5 The effect of protein premiums on nitrogen fertilizer economics (Water treatment C from Figures 1 & 2)