Factors influencing the quality of Montana spring wheat with special emphasis on protein content
by Howard N Watenpaugh

A THESIS SUBMITTED TO THE GRADUATE FACULTY OF MONTANA STATE COLLEGE In Partial Fulfillment of the Requirements For The Degree Of MASTER OF SCIENCE IN AGRICULTURE
Montana State University
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Abstract:
The following thesis is not intended as an exhaustive treatise of the factors which influence the quality of Montana spring wheat, but rather an attempt to summarize the present available information and to discuss the experimental investigations of the author in such a way as to give the reader a comprehensive knowledge of the subject and its most important phases.

It is hoped that this work is conclusive enough to lead the way to a better organized and more scientific study of the factors which influence quality and to a better utilization of this knowledge in producing and marketing of Montana's spring wheat.

# FACTORS INFLUENCING THE QUALITY OF MONTANA SPRING WHEAT WITH SPECIAL EMPHASIS ON PROTEIN CONTENT

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By
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June, 1927

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## PREFACE

The following thesis is not intended as an exhaustive treatise of the factors which influence the quality of Montana spring wheat, but rather an attempt to summarize the present available information and to discuss the experimental investigations of the author in such a way as to give the reader a comprehensive knowledge of the subject and its most important phases.

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## ACKNOWLEDGEMENT

The writer takes this apportunity to express his indebtedness to Professor Clyde McKee for suggesting this problem and for suggestions and encouragement throughout the progress of this thesis; to Professor Arnold Johnson and Professor Edmund Burke for their valuable suggestions; to John Lewis who helped with the experiment of "sampling wheat in the field for protein content" and to many other individuals who have made this project possible. Thanks are also due to the Chemistry Department of the Montana Experiment Station, and to the Montana Grain Inspection Laboratory at Bozeman for analyzing the samples of wheat for total nitrogen content.

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# A STUDY OF THE FACTORS INFLUENCING THE QUALITY OF MONTANA SPRING WHEAT WITH SPECIAL EMPHASIS ON PROTEIN CONTENT

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# FACTORS INFLUENCING THE QUALITY OF MONTANA SPRING WHEAT WITH SPECIAL EMPHASIS ON PROTEIN CONTENT

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## INTRODUCTION

For a number of years it has been recognized that wheats with different physical and chemical characteristics vary in value to the miller and baker. Because of this knowledge the Federal grain grades were established to aid the farmer and the buyer in reaching a fairer value for the particular wheat sold and bought.

Premiums are paid for the better wheats as designated by the Federal grades. It is not uncommon for Hard Spring to sell at a premium of 20 cents to the bushel over the No. 1 grade of the lower subclass Red Spring, or within the subclass, for No. 1 wheat to sell for a premium of 25 cents to the bushel over No. 5 wheat.

Other things being equal millers have shown a preference for wheat of a uniform color and have in the past taken dark, hard and vitreous kernels as indicative of the protein content which is so important in the baking of bread. The development of the Kjeldahl method for determining the percentage of nitrogen has made it possible to economically test wheat for its protein content. The result has been that in the past few years, practically no wheat has been sold at the large spring wheat terminals of this country without a knowledge of its protein content. In many cases, however, the length of time required in sending the samples to testing laboratories prohibits certain

groups of farmers from using the protein test in the marketing of their wheat.

Premiums paid for protein vary to a large extent from year to year depending largely upon the production of high or low protein for the country as a whole. In 1924, wheat with a protein content of 13 per cent brought on the average about 10 cents to the bushel more than wheat with a protein content of 12 per cent, while during the past season (1926) the premiums have not been nearly so large; a rise in protein content between 11 per cent and 12 per cent brought a premium of only 2 to 3 cents to the bushel.

Substantial premiums paid for high quality wheat in the past decade have turned the farmers' attention to the production of such wheat, and the grain buyers' attention to how he can best judge the quality of the wheat with special reference to its protein content.

The quality of Montana wheat as measured by test weight; dark, hard and vitreous kernels; size of kernels; protein content; etc., varies to a great extent, not only from year to year but from community to community and from farm to farm. The importance of studying the effect of cultural treatments, climate, seasonal differences and soil types on quality; the relationship of the different quality factors to each other and to the milling and baking of wheat; and the economic relationship between quality and yield of grain are apparent.

## THE PROTEIN SITUATION

Before starting a study on factors influencing the quality of wheat it is well to consider first the protein situation as it exists at present.

TABLE I

The Average Protein Content of Spring Wheat for Minnesota, North Dakota, and Montana for the Years, 1923-1926

| State | Year | No. tests | Ave. percent Protein |
|---|---|---|---|
| Minnesota | 1924 | 590 | 11.50 |
| (Minnestoa State Dept. | 1925 | 683 | 11.67 |
| of Agr. Bul. #52) | 1926 | 1838 | 12.74 |
| 3 year ave. | | | 11.97 |
| North Dakota | 1923 | 214 | 13.29 |
| (1923-4 N. D. Bul. 191) | 1924 | 316 | 11.33 |
| (1925 U.S.D.A. Bur. Ag. Econ.) | 1925 | 1278 | 11.87 |
| 3 year ave. | | | 12.16 |
| Montana * | 1923 | 1322 | 13.12 |
| | 1924 | 2394 | 13.55 |
| | 1925 | 9271 | 14.29 |
| | 1926 | 10101 | 13.91 |
| 4 year ave. | | | 13.72 |

* Assembled from the records of the Montana Grain Inspection Laboratory at Bozeman, the State Inspection Laboratory at Great Falls, the Bliss Laboratories at Bainville, the Minnesota State Grain Inspection Department at Minneapolis and the Bureau of Agricultural Economics, United States Department of Agriculture.

For years, millers and grain dealers have divided the wheat producing sections of the United States into various districts known as the soft red winter district, the hard red winter district, the hard red spring district and others. They have also made further district divisions which they generally recognize as producing the "strong" wheats and "weak" wheats. Montana, North and South Dakota, and Minnesota comprise what is generally known as the hard red spring wheat section of the United States. Of these states the "strongest" wheats are produced in Montana.

In Table I, which shows the protein content of hard red spring wheat by years for the states where protein information is available, Montana's hard red spring wheat averages over 1½ per cent more than that of Minnesota and North Dakota.

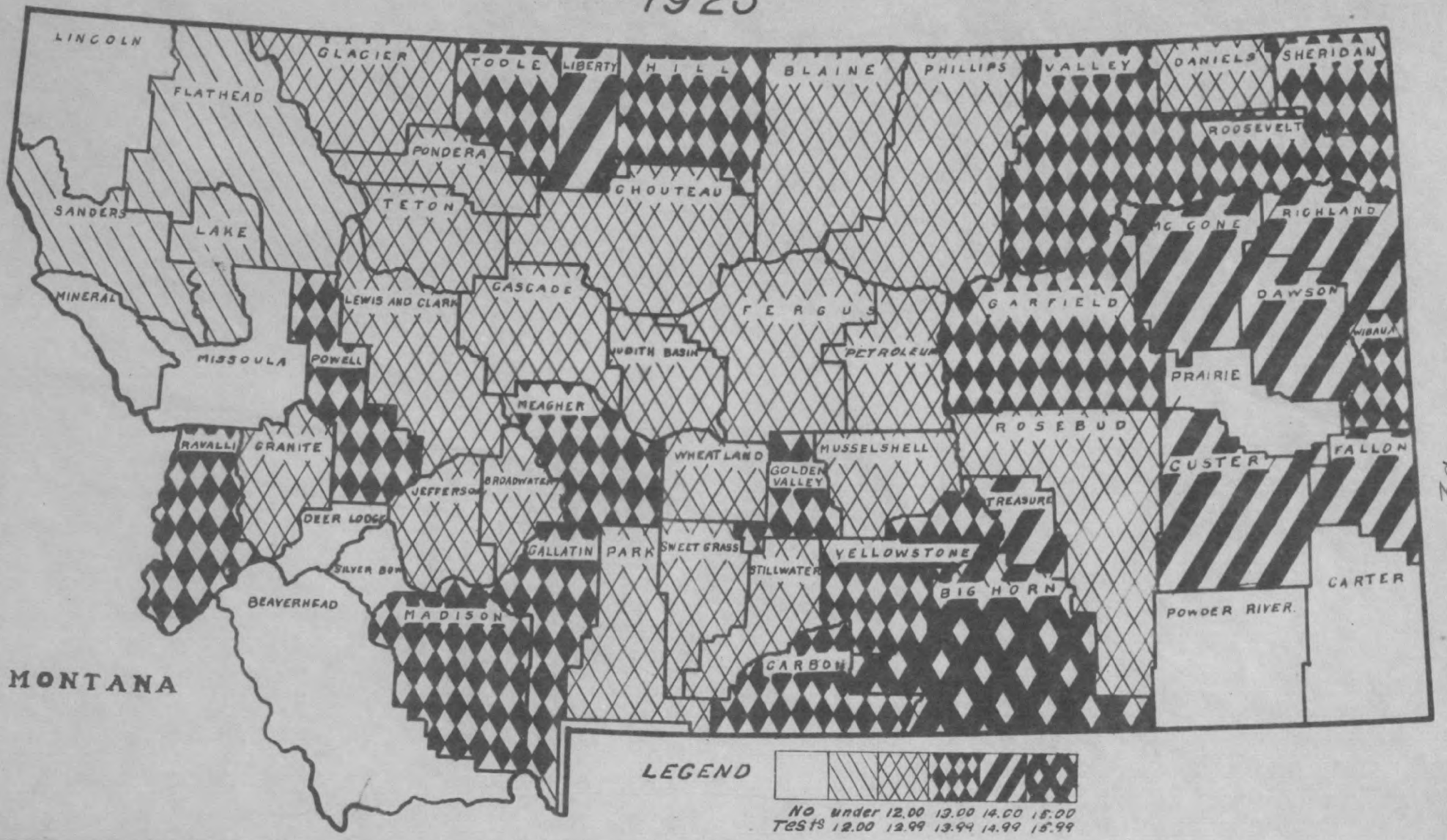
The fact that on the average Montana produces wheat with a higher protein content than any of the other hard red spring wheat states does not necessarily mean that the wheat in all sections of Montana averages high in protein content or that all the wheat in any one section is high in protein.

Maps 1 to 4 inclusive show the average protein content of each county for the years 1923 to 1926 inclusive and Map 5 an average of the four years. Table II gives in more detail the data obtained for each county and Tables XXXIV XX inclusive in the appendix give data obtained for each shipping point within the county.

The maps mentioned above show that the average protein content of hard red spring wheat between counties ranges from 11.00 per cent in 1923 to 16 per cent in 1925 and 1926. Within any one year the largest range was found in 1925, when a number of counties averaged 12 per cent while several

# MAP 1 PROTEIN CONTENT OF HARD RED SPRING WHEAT

## 1923

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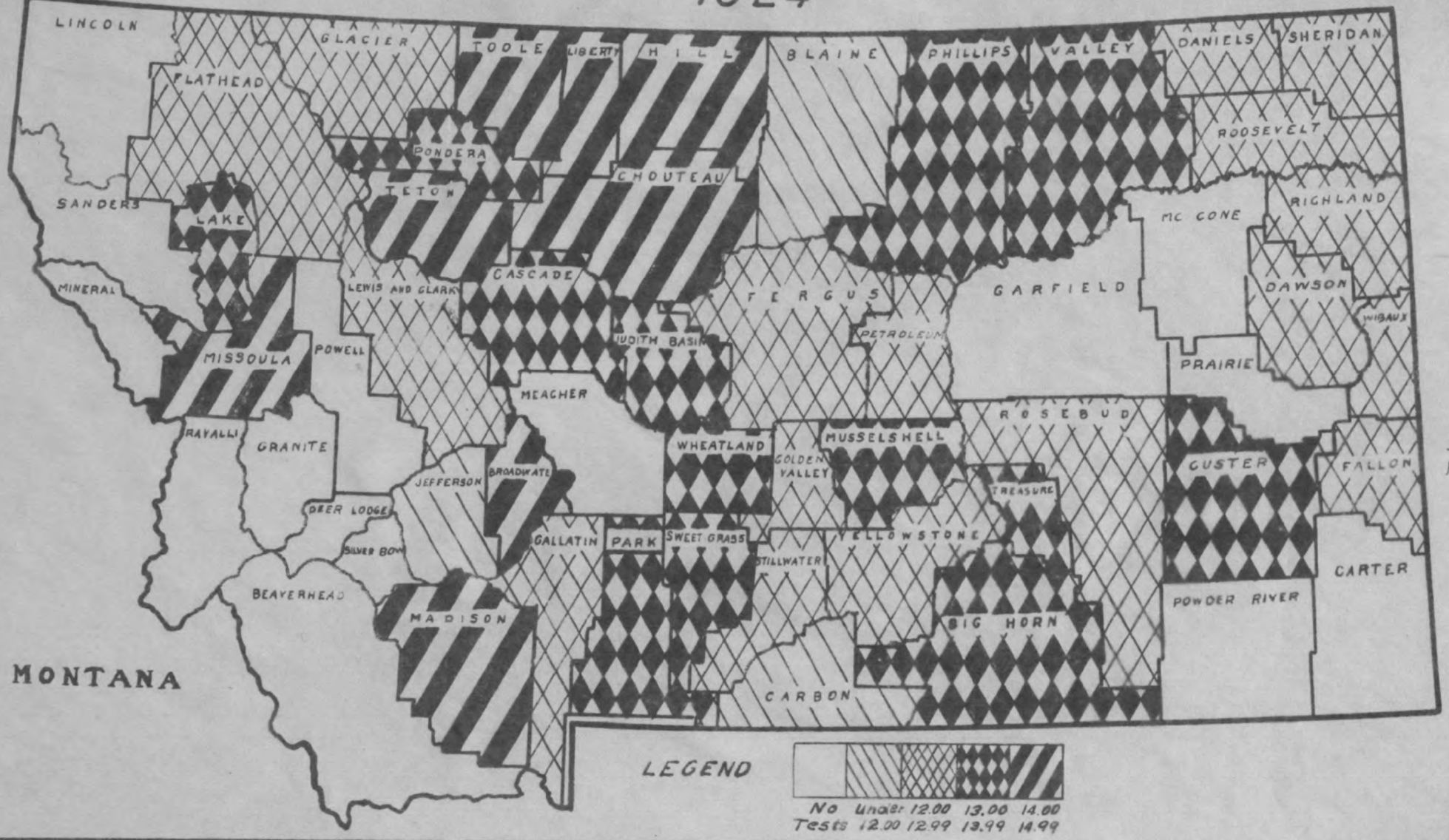
MAP 2

# PROTEIN CONTENT OF HARD RED SRRING WHEAT

## 1924

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