AGRONOMIC AND QUALITY CHARACTERISTICS OF SPRING WHEAT LINES SELECTED FOR PROTEIN CONTENT AND PROTEIN YIELD

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Received 19 June 1981

INDEX WORDS

*Triticum aestivum*, wheat, protein percentage, protein yield, milling and baking data, recurrent selection.

SUMMARY

High protein cultivars of spring wheat (*Triticum aestivum* L.) from eight foreign countries and the United States were used in crosses to provide progeny for a recurrent selection program. After two cycles of selection, 40 lines selected for protein yield and 16 lines selected for protein percentage were evaluated with parents in yield nurseries at Bozeman, Montana.

Lines selected for protein percentage had the highest protein percentages, protein yields similar to the parents, and grain yields lower than the parents. Lines selected for protein yield had protein percentages intermediate between those of the parents and lines selected for protein percentage, but they had the highest protein yields and grain yields. Protein percentage and grain yield were negatively correlated and protein yield and grain yield were positively correlated for both groups of lines. The data tend to suggest that protein yield may a better selection criterion than protein percentage for plant breeders to use in improving protein productivity, although additional testing of this hypothesis is proposed.

Milling and baking data showed transgressive improvement over the mean of the parents in many important quality aspects, indicating that good quality lines can be obtained from crosses involving poor to mediocre quality cultivars.

INTRODUCTION

Grain protein percentage of spring wheat produced in the northern Great Plains has been important to both producer and consumer. The consumer recognizes grain protein as an important item in the baking quality of bread and in the diets of man and animals, and the producer recognizes it as a potential bonus in the market place.

Maintaining and increasing grain protein percentages has been a long-time objective of hard red spring wheat breeders, and this has become more urgent in recent years as grain yield levels continue to increase. JOHNSON et al. (1963) and MIDDLETON et al. (1954) have observed winter wheat progeny with both high grain protein percentage and high grain yield, but finding this combination in recently developed, high yielding spring wheats has not been easy. SCHLEHUBER & TUCKER (1959) have suggested that the major factors responsible for grain protein percentage, in order of importance, are environment, soil, and cultivar.

Cultivars selected from the World Wheat Collection by McNeal et al. (1978) were incorporated into a recurrent selection program in an attempt to concentrate genes for protein percentage. This paper reports agronomic and quality data from the high protein lines after two cycles of intercrossing and testing.

MATERIALS AND METHODS

As reported by McNeal et al. (1978), nine crosses were made in 1967 using U.S. cultivars and high protein genotypes from eight foreign countries. Two F3 lines with the highest protein percentages from each of the nine crosses were then intercrossed in 1970 in all possible combinations to provide material for a second cycle of testing.

One hundred lines from each of 149 second-cycle crosses were tested in F3 progeny rows in 1973 for grain protein percentage (%) and grain protein yield (g). F4 lines with the highest protein percentages, together with those having the highest protein yields, were then evaluated in subsequent field trials for agronomic, protein, and quality characteristics. Forty lines from the protein yield group and 16 lines from the protein percentage group were selected by these tests and seed from them was saved for the agronomic and quality tests reported in this paper.

Eleven parents, the 16 lines from the protein percentage group, and the 40 lines from the protein yield group were planted in dryland and irrigated experiments at Bozeman, Montana in 1980. Each experiment was planted in a randomized block design using four replications of four-row plots with rows 30 cm apart and 3 m long.

The irrigated experiment was planted April 29 and the dryland experiment 3 days later on May 2. Because 20.6 cm of precipitation was received in May and June, the irrigated experiment was irrigated only once, receiving about 10.2 cm of water by sprinkler on July 12 at about flowering time.

Heading date was recorded when 50% of the heads in a plot had emerged from the leaf sheath. Plant heights were measured from ground level to the tip of the tallest heads. Grain yields were obtained by harvesting 2.4 m of each of the two center rows of each plot. Grain protein and flour protein percentages were determined by the Technicon InfraAlyzer 400 R instrument, and grain yields were multiplied by these percentages to obtain protein yield values.

We evaluated flour yield, test weight, farinograph peak, farinograph stability, mixing time, and loaf volume by using standard procedures as previously described by McNeal et al. (1971).

All data were analyzed by the analysis of variance. Duncan's Multiple Range Test was used to test means for significant differences.

RESULTS AND DISCUSSION

The irrigated and dryland experiments grown in 1980 averaged 5213 and 4513 kg/ha, respectively, but there was no interaction between lines in the two tests so agronomic data from the two nurseries have been combined.

The combined data show that selecting for protein percentage and protein yield were each effective in improving protein percentage and protein yield of lines (Table 1). Parents averaged 14.9% protein compared to 16.2% for the protein percentage