YRB 81-02

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SUBJECT: 1980 Wheat Objective Yield Study

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In response to the concern that the 10-inch measurement for counting stalks may not be providing accurate forecast information, a research project was conducted in North and South Dakota during 1980. New dwarf varieties have been developed which often do not reach a stalk height of 10 inches by late boot (code 3) and rarely that height in early boot (code 2). The count of stalks 10 inches tall is an important parameter to the objective yield forecast model and should reflect the potential yield.

Since the 10-inch measurement was chosen at the beginning of the objective yield program, this project was designed to determine if an optimum measurement at which to make counts could be found. To do this, a third unit was laid out in selected objective yield sample fields in North and South Dakota. Stalk counts at 6, 8 and 10 inches were made when the unit was at maturity code 2 and/or 3. In addition, final head counts were made in the unit just prior to harvest, code 6 or 7.

The data for both states were edited for consistency and reasonableness. Because of data collection problems, the South Dakota set could not be used for analysis. The remainder of this memo will discuss the analysis of units in North Dakota.

The analysis was designed to identify the optimum stalk height to make stalk counts for forecasting the final number of heads. Correlation between stalk counts and head counts were run to determine which count was best correlated with final head count. A regression line was fit to the data using counts at each measurement as the independent variable and final number of heads as the dependent variable. The analysis was done by maturity stage. Those units that were code 2 when the unit was laid out were analyzed separately from those that were code 3. The regression and correlation results are in Table 1.

| Code | HT | n | R | $R^2$ | CV | F | Model |
|---|---|---|---|---|---|---|---|
| 2 | 6 | 26 | .56 | .31 | 29.3 | 11.03 | y=.38x+55 |
| 2 | 8 | 26 | .52 | .27 | 30.3 | 8.76 | y=.36x+59 |
| 2 | 10 | 26 | .55 | .31 | 29.5 | 10.60 | y=.39x+62 |
| 2 | All stalks | 26 | .80 | .64 | 21.3 | 42.40 | y=.56x+24 |
| 3 | all stalks | 54 | .85 | .90 | 16.1 | 486.30 | y=.85x+6 |
| 3 | 6 | 54 | .94 | .89 | 17.0 | 433.95 | y=.82x+12 |
| 3 | 8 | 54 | .93 | .86 | 19.4 | 318.00 | y=.78x+18 |
| 3 | 10 | 54 | .90 | .80 | 23.1 | 210.76 | y=.74x+24 |

To compare the slopes between two different regression lines, the statistic $t = \frac{\bar{d}}{S_{\bar{d}}}$ was used to test the null hypothesis that the difference between the slopes is 0. The slope (b) of the regression line is defined as:

$$b = \frac{\Sigma(X_i-\bar{X})(Y_i-\bar{Y})}{\Sigma(X_i-\bar{X})^2}$$

where $X_i$ is the independent variable, $Y_i$ is the dependent variable.

To compute $\bar{d}$ on the difference between the slopes of two regression lines (6 & 8 inch, 6 & 10 inch, etc.) we compute $d_i = b_{i1} - b_{i2}$ where i represents the observation and 1 and 2 represent the regression lines associated with the slope $b_i$.

Using the procedure shown in Applied Linear Statistical Models by Neter and Wasserman (p. 55) the slope for an observation i can be represented by:

$$b_i = \frac{(X_i-\bar{X})Y_i}{\Sigma(X_i-\bar{X})^2}$$

Therefore, $d_i$ becomes $d_i = \left[\frac{(X_{i1}-\bar{X}_1)}{\Sigma(X_{i1}-\bar{X}_1)^2} - \frac{(X_{i2}-\bar{X}_2)}{\Sigma(X_{i2}-\bar{X}_2)^2}\right] Y_i$

Note $Y_i$ will be the same for both slopes 1 and 2 as the final head count is the same for both measurement heights. The high correlation between the height counts is accounted for by using this procedure. Table 2 shows the results of the paired differences test.

Table 2.--Mean Difference of Regression Slopes

| Stage | Comparison | N | Mean Difference | Standard Error of Mean | T |
|---|---|---|---|---|---|
| 2 | 6 & Stalks | 26 | .1748 | .5383 | .32 |
| 2 | 6 & 8 | 26 | .0210 | .0944 | .22 |
| 2 | 6 & 10 | 26 | -.0089 | .1599 | -.06 |
| 2 | 8 & Stalks | 26 | .1958 | .5515 | .36 |
| 2 | 8 & 10 | 26 | -.0299 | .1007 | -.30 |
| 2 | 10 & Stalks | 26 | .1659 | .5498 | .30 |
| 3 | 6 & Stalks | 54 | .0268 | .0566 | .47 |
| 3 | 6 & 8 | 54 | .0361 | .0295 | 1.22 |
| 3 | 6 & 10 | 54 | .0766 | .0613 | 2.25 |
| 3 | 8 & Stalks | 54 | .0630 | .0783 | .80 |
| 3 | 8 & 10 | 54 | .0405 | .0430 | .94 |
| 3 | 10 & Stalks | 54 | .1034 | .0978 | 1.06 |

(t .9 25) = 1.316 (t .9 53) = 1.299
(t .95 25) = 1.708 (t .95 53) = 1.675
(t .99 25) = 2.485 (t .99 53) = 2.008

The results of the test show that within each maturity stage the difference between any of the slopes is not significant. Therefore, we must accept the hypothesis that the mean differences are 0 and that stalk counts made at various heights predict final head count similarly.

Referring back to Table 1, we note the $R^2$ within each maturity stage are of the same magnitude. One $R^2$ in each maturity class stands out, that being the one using all stalk counts as the independent variable. Its performance was better than any of the height measurements. In Table 2, the [illegible] differences indicated that the two slopes were statistically the same.

The results from the 1980 survey show basically two things:

1. Current 10-inch measurements procedures predict final head counts as well as the 6 and 8-inch measurements.

2. All stalk counts could predict final head counts without the use of equipment.

These results were based on a small sample, in one state, and for spring wheat. The data also was collected under less than ideal circumstances. The preparation time for the survey was very limited so procedures and techniques were not clearly presented. While the procedures were simple, there were no provisions for checking the data collection work. In addition, the 1980 crop season in North Dakota was extremely dry. This resulted in poor germination, weedy fields, and a generally atypical crop.

For the 1981 crop season the procedures should be included as a regular part of the Wheat Objective Yield Survey in 2 or 3 winter wheat states and in North Dakota. Possible winter wheat states which would have a high percentage of code 2 samples would be Oklahoma and Nebraska.

By including the research project as a portion of Objective Yield Program better instruction can be made at the national school. Once common instructions are provided, better state-level supervision can be expected.

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