1969 Wheat Mowing Study in Missouri, Colorado, and Oregon

A few years ago members of the Methods Staff of Agricultural Estimates Division began questioning some procedures used in the wheat objective yield survey. Questions raised involved possible selectivity bias in heads clipped for laboratory analysis and differences between units within a sample. To resolve these questions, two studies were completed in 1968 and based on the results of these studies the 1969 study was made.

The results of studies completed in Idaho and Illinois during the 1968 season prompted the recommendation, from the Methods Staff of AED, that procedural changes be initiated for further study - in three States in 1969. The study in Idaho was performed to determine the source of variation in head weight. The analysis of the Idaho data indicated that there is a significant difference between sample units. Thus, it is inefficient to forecast head weight with heads clipped from beside only one of the two sample units.

The Illinois study was conducted to determine if selectivity bias (in the ten head subsample obtained for laboratory analysis) could be eliminated by mowing the stalks before the heads are removed. To obtain a subsample of heads from each unit, the total number of heads per sample must be increased or fewer heads obtained per subsample. Increasing the total number of heads would place a heavier workload on the laboratories. Therefore, an attempt was made to determine if selectivity bias could be eliminated by a mowing operation. Analysis of the 1968 Illinois data indicated no significant difference (at the 99 percent level) between the average head weight of the 10 head mowed subsample and the average head weight of the remaining heads.

More details of the 1968 Idaho and Illinois studies are included in attached papers.

On the basis that there exists a significant difference in head weight between sample units and that it appears possible to reduce or eliminate selectivity bias by a mowing operation, the clipping procedures were changed in the three States in 1969. The 10 head subsamples were obtained by mowing the stalks before removing the heads. This should eliminate the tendency to overlook smaller heads. In Missouri and Colorado, the 10 head subsample was obtained by mowing two five head subsamples (one subsample to represent unit I and one to represent unit II).

Procedures Followed:

Obtain the 10 emerged head subsample for Form C-1 by mowing two 5-head subsamples. One 5-head subsample is to represent unit I and the second, unit II. To obtain the remaining emerged heads and late boot, clip approximately 1/2 of the balance of the row from which the 5-head subsample was obtained. A special Form C-1 was used so that the data from each unit would be kept separate for later analysis. The data needed for current forecasts was obtained by summing across the two units of a sample.
The following diagram depicts the layout of the sample and clip units.

xxx = 5 head subsample obtained by mowing.

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Row 1 was used for the first month a C-1 was required, Row 3 the second month, and Row 2 the third, if required. The mowing operation in Row 2 will not affect the unit as generally if the 3rd C-1 is taken, the sample is in category 6 or 7 in which case the sample is harvested also.

The mowing procedure for use in 1969 in Missouri and Colorado was to mow 5 stalks approximately 2 inches above the ground, without determining that each of the stalks mowed had a head. After the 5 stalks had been mowed, the heads were clipped and placed in a bag. If there were not 5 emerged heads on the 5 stalks, repeat the process mowing sufficient stalks to obtain 5 emerged heads. This procedure was repeated until 5 emerged heads were obtained. Any heads in late boot obtained during this process should be placed with the "remaining heads and late boot clipped".

The procedure for Oregon was merely a repeat of the work done in Illinois during 1968. Here a 10-head-subsample was obtained by the mowing procedure from one row beside the unit. In essence this procedure differs from the current procedure only in laying out two clip units beside Unit I and the mowing operation to obtain 10 emerged heads. See the following diagram:

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Analysis of Data:

The table below indicates comparisons made and t values obtained. The only independent test showing a significant difference was the comparison between the five head subsample and remaining heads for Unit II in Missouri.
Table of Comparisons

<table>
<thead>
<tr>
<th>State</th>
<th>5 Head Subsample vs 10 Head Subsample</th>
<th>5 Head Subsample vs Remaining Heads</th>
<th>5 Head Subsample vs 5-Head Subsample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit I vs Unit II vs vs RemainingHeads</td>
<td>Unit I vs Remaining Heads From Unit(s)</td>
<td>Unit I vs 5-Head Subsample</td>
</tr>
<tr>
<td>Mo.</td>
<td>t Value</td>
<td>d.f.</td>
<td>t Value</td>
</tr>
<tr>
<td></td>
<td>1.109</td>
<td>109</td>
<td>3.210**</td>
</tr>
<tr>
<td>Col.</td>
<td>0.331</td>
<td>94</td>
<td>-0.597</td>
</tr>
<tr>
<td>Ore.</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The comparisons presented above are not all independent comparisons. Considering that these procedures are theoretically sound and more efficient than the old procedures and the fact that there was only one significant independent difference, it appears we should adopt the mowing procedures and the two five head subsamples. The first year the data should be kept separate by subsample for further analysis on the 1970 data.
Objective Yield Must - Selectivity Bias in Selecting 10-head Subsample

For Laboratory Analysis

Each month in which the wheat is in category 3 or above, one not approximately
26 inches long from the clipping unit, which is laid out directly adjacent
to the clipping unit, is clipped for laboratory analysis. A 10-head sub-
sample, which in the first 10 heads cut, is analysed separately from the
remaining heads and last head from the clipping unit. These data are then
recorded on Form 8-1.

Over the past several years it has been noted that more selectivity bias
exists in the selection of the 10-head subsample. The heads in the 10-head
subsample usually weigh somewhat more than the remaining heads in the row.
This is a natural phenomenon in that heads, being that they are, always
try to select the somewhat better or healthier heads. Secondly, in wheat
that stands from two to three feet tall and the enumerator is clipping the
heads from an upright position, there is a tendency to select the heads that
are on the tallest stalks which have had better growing conditions as to
sunlight, etc. and will not obtain heads on the lower part or small stalks
bent over, etc. Therefore, the 10 heads will probably be somewhat heavier
than the remaining heads.

In addition, it seems desirable to have a clipping unit beside each of the
clipping units. Hence, in a situation where the clipping units have a
significantly different head weight, it is most insufficient to try to estimate
the head weight from a subsample beside only one unit.

The use of a clipping unit beside each of the clipping units prior to this
time had not been considered because if there is truly a selectivity bias, we
could not afford to reduce the number of heads clipped from 10 because
of increasing selectivity bias. However, on the other hand, if the 10-head
subsamples were clipped, the amount of work in the laboratory could be doubled.
A small project was set up in Illinois during the 1953 growing season
to determine if the selectivity bias could be eliminated by using a mutation
procedure. The enumerators were instructed to cut ten stalks about two
inches above the ground. Then they were to clip the heads from those stalks.
If they did not have ten emerged heads, they were to cut a sufficient number
of stalks to obtain ten. This process was repeated until a 10-head subs-
example was obtained. Illinois was requested to have a supervisory enumerator
check each sample area prior to the year to see if the sampling procedure
was followed strictly. Plots were laid out in the manner depicted by the
following diagram.