Application of the Shortcut Method for Estimating the Standard Deviation

Statistics have helped the plant breeder to better understand the biological material with which he works. Often times simple statistics such as the means or standard errors are sufficient to obtain an insight into certain creeding materials. In many sugar beet breeding programs several thousand mother roots are selected each year. Each beet usually is given a number, weighed and tested for percent sugar. The resulting data are recorded and the general mean calculated. The mass selection method was refined by Powers (2)[2] when he developed the unit-block method of selection. Powers' method utilized inbreds and/or F_1 hybrids within each unit-block to measure the environmental variation. A modification of this method would be to harvest several mother beets within a unit-block, obtain the block mean for the characters being studied and note the range.

By using the range and the number of observations an estimated standard deviation could then be calculated by utilizing the formula, s/Range = mean ratio, or s = range $\times$ mean ratio. This shortcut method is described in Snedecor's "Statistical Methods", Table 2.2.2, on pages 38-44 (3). This procedure was used by Finkner et al. (1) in selecting mother beets for high and low aspartic acid and similarly for glutamine content. Once the standard deviation has been determined, the degree of selection pressure can be applied by choosing the beets which are beyond the mean by one or two standard deviations. The variances also are readily calculated by squaring the standard deviation.

The reliability of this method is shown in Table 1 for aspartic acid where it is compared with the actual calculation of the standard deviation. Good agreement between the two methods was found.

An example of how this shortcut method was used is shown below. There were 22 beets selected from unit-block, A-1, and analyzed for aspartic acid. The mean of the 22 beets for aspartic acid content was 0.18. The known range was 0.34 -0.08 = 0.26. The range (0.26) was then multiplied by the "ratio mean" which was found in Snedecor's Table 2.2.2. The "ratio mean" for 20 beets was .268. Therefore, the equation becomes 0.26 $\times$ .268 = the standard deviation of .070. The usual method of calculating

Table 1.—Comparison of two different methods for calculating the standard deviation.

Unit blocks	s/Range = Mean Ratio	$\sqrt{\frac{\Sigma(x)^2 - \frac{(\Sigma x)^2}{n}}{n-1}}$
A-1	0.070	0.063
A-2	0.083	0.078
A-3	0.066	0.074
A-4	0.146	0.136
A-5	0.085	0.088
A-6	0.088	0.087
A-7	0.103	0.124
A-8	0.072	0.096
A-9	0.145	0.131
A-10	0.090	0.098
A-11	0.104	0.116
A-12	0.113	0.118
Mean	0.097	0.101

the standard deviation was found to be .063. The 2 estimates are very close to each other.

This simple, quick, reliable method of estimating the standard deviation can be a valuable guide in applying selection pressure for any characteristics being studied.

Literature Cited

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