26 April 1932.

Dr. O. Tedin,
Svalof,
Sweden.

My dear Tedin:

I was interested in your letter of 12 April 1932, and thought it would be a good opportunity to let Mr. J.W. Hopkins from Alberta, Canada, who is working on these problems in my laboratory, introduce himself to you by discussing your problem.

I agree entirely with his solution, and hope it will meet your case.

Yours sincerely,

26 April 1932.

Dr. O. Tedin,
Sveriges Utsädesförening,
Svalof,
Sweden.

Dear Dr. Tedin:

Thinking that the problems would interest me, Dr. Fisher has turned your letter of 12 April 1932, over to me. Perhaps I should explain that I am not a permanent member of the Rothamsted Statistical Department, but expect eventually to return to Canada, where I shall be attached to the National Research Council, Biological Division.

Your first question was concerning the variability of the difference in mean height between progeny from selfed and unselfed seed, and a number of parent plants. Supposing equal variance within all groups, let this be denoted by σ^2. Then if we let $\bar{H}_2 - \bar{H}_1$, the difference in mean plant height = ξ, a series of quantities $\xi_1, \xi_2, \ldots\ldots \xi_p$, having standard errors $\sigma_1, \sigma_2, \ldots \sigma_p$, where p is the number of maternal plants, can be formed. The hypothesis now to be tested is that $\xi_1 \ldots\ldots \xi_p$ are really estimates, of varying precision of some quantity $\bar{\xi}$. If $\bar{\xi}$ be estimated from

$$\sum_1^k\left(\frac{\xi}{\sigma^2}\right) \div \sum_1^k\left(\frac{1}{\sigma^2}\right)$$

this estimate of $\bar{\xi}$ will make $\sum_1^k\left\{\frac{1}{\sigma^2}(\xi-\bar{\xi})^2\right\}$ a minimum for variations of $\bar{\xi}$.

Let

$$\frac{\sum_1^k\left\{\overset{n_1}{\underset{1}{S}}(H_1-\bar{H}_1)^2+\overset{n_2}{\underset{1}{S}}(H_2-\bar{H}_2)^2\right\}}{\sum_1^k\left\{n_1+n_2-2\right\}}=s^2$$

Then our estimate of the σ of any ξ will be found by multiplying s^2 by the appropriate $\left(\frac{1}{n_1}+\frac{1}{n_2}\right)$. Furthermore since the variance of $\bar{\xi}$

$$V(\bar{\xi})=\frac{1}{\sum_1^k\left(\frac{1}{\sigma^2}\right)}$$

of which our best estimate is

$$\frac{s^2}{\sum_1^k\left(\frac{n_1 n_2}{n_1+n_2}\right)}$$

the quantity

$$\sum_1^k\left\{\frac{n_1 n_2}{n_1+n_2}(\xi-\bar{\xi})^2\right\}$$

is a valid estimate of $(k-1)\sigma^2$, and may be used as an estimate of interclass variance. The intraclass variance will be given directly by

$$\sum_1^k\left\{\overset{n_1}{\underset{1}{S}}(H_1-\bar{H}_1)^2+\overset{n_2}{\underset{1}{S}}(H_2-\bar{H}_2)^2\right\}$$

The analysis of variance therefore becomes:-

	Degrees of Freedom	Sum of Squares
Interclass	$p - 1$	$\sum_{1}^{p}\left\{\frac{n_1 n_2}{n_1 + n_2}\left(\xi - \bar{\xi}\right)^2\right\}$
Intraclass	$\sum_{1}^{p}(n_1 + n_2 - 2)$	$\sum_{1}^{p}\left\{\sum_{1}^{n_1}(H_1 - \bar{H}_1)^2 + \sum_{1}^{n_2}(H_2 - \bar{H}_2)^2\right\}$

With regard to your second question, the estimation of the correlation by an adequate system of weighting would be laborious in the extreme. The gain in precision of estimation, as a result of weighting, will diminish with increasing numbers in the various classes, and Dr. Fisher is of the opinion that in any case it would not be worth the labour involved. He therefore advises the estimation of the correlation in the ordinary way from the various class means, ignoring all differences in weight.

Yours sincerely,