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DIVISION OF AGRONOMY AND PLANT GENETICS

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Galton Laboratory
University College
London, W.C. 1
England

Dear Dr. Fisher:

I am in difficulty regarding a little problem and wonder if you would be willing to help me out. My thinking isn't clear and I can't get the problem straightened out.

During the past two years, in yield tests with a large number of varieties, we have arranged the varieties in sets of equal numbers and then used randomized block trials. In the example given below we had 68 varieties (hybrids) of corn to test in a yield trial. We separated these into 4 sets of 17 each. Two uniform check varieties were added to each set, making 19 varieties per set. The 4 sets were randomized in each of 6 replicates and the varieties were randomized in each set, the same varieties always occurring in the same set. In one of these tests we obtained the following:

Variation due to:	D.F.	Mean Square	
Replications	5	242.88	
Sets	3	757.61	
Repl. x sets = ~~V_a~~	15	172.18	$= V_a$
Varieties within sets	72	286.13	
Within varieties in same sets = ~~V_b~~	360	25.39	$= V_b$
Total	455		

Variance (b) $[V_b]$ would be appropriate for comparing varieties always occurring in the same set. Would V_a be appropriate for comparing varieties in different sets? It would be appropriate for comparisons of the means of the sets but would it hold also for individual varieties in different sets? I've never known how to answer that question.

For comparing varieties in different sets I worked thru the uniform checks (which are repeated in all sets) and then used variance (b). For comparing variety 1 in set A and variety 24 in set B, I made comparisons of

$(1\text{-}\overline{2\ ch_A}) - (24\text{-}\overline{2\ ch_B})$ where $\overline{2ch_A}$ and $\overline{2ch_B}$ are the means of the two checks in the two sets containing varieties 1 and 24. Should the difference between 1 and 24 be corrected by means of the checks in each set, considering that we have a randomized block type of experiment? The error I used was

$$\frac{1}{r}\left[\left\{V_b + \frac{V_b}{2}\right\} + \left\{V_b + \frac{V_b}{2}\right\}\right]$$ where r is the number of replications.

Is this correct?

Dr. Coulden told me that he that you had once given him the following method for comparing varieties in different sets. The comparison of varieties 1 and 2$_4$ could be set out as:

$1 - 2_4 = (1-\bar{1}) - (2_4-\bar{3}) + (\bar{A}-\bar{B})$ where $\bar{A}$ and $\bar{B}$ are the means of the two sets, and contain varieties 1 and 2$_4$, respectively. The error variance would then be

$$\frac{1}{r}\left\{\frac{(N-1)}{N} V_b + \frac{(N-1)}{N} V_b + \frac{2}{N} V_a\right\} = \frac{2}{Nr}\left\{(N-1) V_b + V_a\right\}$$

where N is the number of varieties per set. This method would give a lower error for comparing varieties in different sets and it would also mean that the check varieties could just as well be omitted from the test.

In this example V_a is almost six times V_b. This ratio of V_a to V_b, in our limited experience with this type of test, varies from about 3:1 to almost 20:1.

In the above example we were particularly interested in comparisons within sets, with less interest in comparisons between varieties in different sets. In the future we will consider pseudo-factorial arrangements in order to get around the difficulty of such great contrasts in V_a and V_b. If the error variance between varieties in different sets, of:

$$\frac{2}{Nr}\left\{(N-1) V_b + V_a\right\}$$

is appropriate the older method isn't as bad as I had feared it was.

I plan to teach pseudo-factorial and symmetrical incomplete block arrangements to the graduate students this spring. With the papers by Yates and Coulden's "Outlines" before me I can work out the methods fairly readily. Dr. Coulden has set up the mechanics of the calculations very nicely. Has the revised edition of your Design of Experiments been published yet? I haven't seen it.

We appreciated your picture at Christmas-very much. That was a fine likeness and we certainly appreciate receiving it.

Dr. E. G. Anderson from the California Institute of Technology was here this past winter teaching a course in Genetics. He did a good job on chromatid crossing over and its consequences, and on the use of interchanges (reciprocal translocations) in maize. Dr. Anderson is working with more than 100 different interchanges. Combining the linkage data from these with cytological measurements on the interchanged chromosomes in pachytene he can map the physical chromosome of maize at about the stage when crossing over is supposed to occur. The Drosophila people are handicapped because they can study only metaphase

chromosomes which may not have shortened uniformly thruout their length. Dr. Anderson should accumulate data in the next few years with which it will be possible to attack the problem of the nature and extent of interference in the pachytene chromosomes of maize. After spending my spare time last winter thinking about genetics I must turn my thots back to statistics for a time.

Sincerely yours,

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Agronomy and Plant Genetics