

New York State College of Agriculture
Cornell University
Ithaca, N. Y.

March 7, 1923

To Students of Corn Genetics : -

Recent developments in corn genetics studies make it important that those of us who are working with this material agree on a factor notation that shall be as nearly uniform as possible. It seems wise to follow the notation used by the *Drosophila* workers, in so far as practical, tho, in some respects, their usage is perhaps no more nearly consistent than our own.

Some of the problems that deserve attention are outlined below.

We now have several instances of practically indistinguishable phenotypes that are differentiated from the normal by distinct genes. We have heretofore designated white seedling by w, but there are certainly six and presumably many more non-allelomorphic genes for white seedling. Shall we attempt to find distinctive names for all these or call them all w and identify them further by number? If the latter plan, which I personally prefer, is adopted, shall we use Arabic or Roman numerals and shall they be written as subscripts or full size numerals: w₁, w₂, w₃; w_I, w_{II}, w_{III}; w₁, w₂, w₃; w_I, w_{II}, w_{III}?

It has been proposed that Roman numerals, either as subscripts or not, be used for any such gene which has not as yet been placed in a linkage group and that Arabic subscripts indicating the group number be employed for such as have been so placed. As ~~more~~

and more of these genes are located in linkage groups, the Roman numerals would be replaced by Arabic subscripts. Thus, WI (or W_I), W₂, WVI (or W_{VI}) might ultimately be written as W₇, W₂, W₁₀, etc. Is there any advantage in indicating this much of the linkage relations of genes by the gene symbol? Is there any more reason for showing something of a gene's linkage relations by its symbol than for indicating by a characteristic suffix that a gene is one of duplicate or of complementary factors? Is there any more reason for indicating group relations of such genes as the several ones for white seedling than for liguleless leaf, shrunken endosperm, etc., say: lg₅, sh₂, etc.?

In case group relations are to be indicated by a numerical subscript, what shall be done with the three w genes that are now almost certainly known to belong to the Y - Pl group? Shall we use the symbols w_{2a}, w_{2b}, w_{2c} (assuming that the Y - Pl group is regarded as the second one)?

If numerical subscripts or full size figures are used to identify such genes as those for white seedling, we should doubtless adopt the same plan for defective endosperm (de), zebra striping (zb), zigzag culm (now z and zg), virescent seedling (v), pale green seedling (pg), piebald (pb), tassel seed (now ts and te, with one or more unnamed).

But how about colorless aleurone? Should we abandon the symbols a, c, r, l, that have an established place in the literature of corn genetics and use say: a₁, a₂, a₃, A₄, or perhaps e₁, e₂, e₃, C₄? If group relations were to be indicated here, we might have a₇, a_{1a}, a₃, A_{1b} or e₇, e_{1a}, e₃, C_{1b}. Our present Aa and Rr pairs affect plant, silk, and anther, and pericarp colors in

various ways while Cc and Ii are not known to do so, which may be reason enough for not bringing the aleurone factors under this scheme. The relation of Aa to plant, silk, anther, pericarp., and aleurone colors is a simple one and, therefore, presents no serious difficulties, but the R^r, R^g, r^r, r^g, r^{ch} series would be difficult unless the interpretation of multiple allelomorphism, be changed to one of close linkage of several distinct genes.

I assume that the plan outlined in this letter need not change our symbols for the several forms of dwarf plant; dwarf (d), brachytic (bc), nana (na), brevis (br), etc., because these dwarfs are sufficiently unlike morphologically to be more or less readily distinguishable. If, however, as seems probable now, there are two indistinguishable dwarfs, they will, I assume, have to be known as d₁ and d₂, or perhaps as dI and dII until their group relations are established.

There is being prepared now a general paper on corn linkage in which a summary of all available information is to be presented. It seems wise to me to number the linkage groups, whether or not any genes are to be given group numbers. In what order shall the groups be numbered? Shall priority of publication of any linkage determine the numerical order? Or shall the order be determined arbitrarily? While priority of publication might seem the better basis, there are certain difficulties. Both Eyster and Hutchison, while not numbering the groups, discussed them in the supposed order of priority, as follows: A - wx, g - R, su - Tu, B - lg, Y - Pl, P - f. Jones gave the same order for the first three of this group. But Kempton in March 1917, published a brief

paper showing unmistakably a linkage between yellow endosperm and white seedling. Whether this paper was overlooked by Eyster, Hutchison, and Jones or whether it was left out of account because of doubt as to what white seedling gene was concerned or as to whether one or more than one yellow gene, as suggested by Kempton, was involved, makes little difference. The point is that if priority were taken as the basis for numbering the groups and they had been numbered by Eyster and Hutchison, someone might now or later claim the right to change the Y - Fl group from No. 5 to No. 2. Or if we now, on the basis of priority of publication, decide to call the Y - Fl group No. 2, what is to prevent someone later claiming that the g - R group is No. 1, thus making C - wx and Y - Fl Nos. 2 and 3, respectively, on the basis that what has recently been regarded as a multiple allelomorph series, namely, R^x, R^g, r^x, r^g, r^{ch}, etc., is better interpreted as very close linkage between genes for aleurone, leaf, silk, anther, and pericarp color, and citing Webber's 1906 paper as the first one on corn linkage? I would personally prefer to have the corn-genetics men in this country adopt group numbers arbitrarily and then adhere to them rather than to have the numbers changed later by the discovery of some earlier paper. I suggest, therefore, that we number the groups in the order given by Eyster and by Hutchison, as follows:

- 1- C - wx
- 2- g - R
- 3- su - Tu
- 4- B - Lc
- 5- Y - Fl
- 6- P - f

These are the only published groups so far as I know, except gs - zr to which apparently an also belongs, and it is not certainly known that this group may not belong to one of the six listed above. The same is true of d - pg, fr - gl - v, and doubtless others. Perhaps the A - v group (Stroman) should be No. 7, because A almost certainly does not belong with any of the six groups listed above. It might be better, however, to assign no numbers to groups other than the six listed above until the newer groups have been tested further.

Another problem is bothering some of us. Shall we continue to use bi-literal symbols for genes as we have usually done in the past, or adopt the recommendation of the Naturalists' committee to use single-letter symbols? It is my understanding that the practice of Genetics of setting the second letter of a bi-literal symbol as a subscript was adopted by Dr. Shull because of this rule. Thus, our B (plant color), bl (blotched leaf), bc (brachytic culm), bh (blotched aleurone), etc., which have no close relation one to another, all become B symbols with literal subscripts to distinguish one from another. I fear this usage will be confusing. Would it not be likely to give the idea that the several "B" symbols stand for similar phenotypes just as our proposed w₁, w₂, w₃, etc., do? If the corn men desire to stick to the use of bi-literal symbols, we shall probably have to refrain from publishing in Genetics or have our symbols changed by the editor when papers are published there. It is interesting to note that, while Genetics has been consistent in setting the second letter of two-letter symbols as subscripts in the text, it has allowed the form we are accustomed to stand in drawings, as seen in some *Drosophila* papers.

It is true that certain difficulties are avoided by making the second letter of a bi-literal symbol a subscript. If a genetic formula be written, thus, blgpr, it may be wholly unintelligible to us. Following the usage insisted on by Genetics, it would become b₁gpr, bl_gpr, or blgp_r, etc., which mean very different types. We have accomplished the same thing as you know by writing these formulae bl g pr, b l_g p r, b l g pr, etc. I personally very much prefer our usage to that of Genetics, but if the majority of corn men think best to adopt the plan followed by Genetics, I shall use it. I hope that we can determine soon what is best for us to do for I have a paper in press now that I shall want to revise if we adopt the Genetics plan.

I am sending this to a considerable number of corn-genetics workers. When I have received replies from the majority, I may want to refer some of our problems to the chairman of the Naturalists' committee with the suggestion that he consider the advisability of referring it to the committee for consideration.

Sincerely,

(signed) R. A. Emerson

RAE:V