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This Week's Citation Classic®

Sprague G F & Tatum L A. General vs. specific combining ability in single crosses of corn. *J. Amer. Soc. Agron.* **34**:923-32, 1942.
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This paper deals with the development of quantitative genetic techniques to assess the relative importance of additive effects ($\sigma^2_{\hat{g}}$) and nonadditive effects ($\sigma^2_{\hat{s}}$), designated as general and specific combining ability, in trials of single-cross corn hybrids. Implications of the estimates to the evaluation of new inbred lines are discussed. [The *SCI*® indicates that this paper has been cited in over 115 publications since 1955.]

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Much research in applied fields is initiated in an attempt to solve current problems. This was particularly true of the paper dealing with general and specific combining ability in corn. Hybrid corn had been introduced in the 1930s and adoption was progressing rapidly in the major corn-producing states. The first inbred lines used had been developed from open-pollinated varieties. Experience with further sampling of varieties had been relatively unproductive. The isolation of new inbred lines from current hybrids was found to be less productive than anticipated.

Earlier, population genetics had received attention from such scholars as Wright[1] and Fisher.[2] The relevance of these findings to animal breeding had been emphasized by Lush,[3] but comparable work in the plant field was lacking. Quantitative genetics, which differs from population genetics in stressing the role of selection in controlled populations of known ancestry, was still in its infancy.

It was obvious to corn-research workers that there was ample genetic variability in the populations under study. The failure to achieve the continuing gains expected from new line development indicated that our knowledge of the types of gene action involved in combining ability (yield heterosis) was far from adequate.

We postulated that data accumulated in the course of the routine evaluation of the combining ability of inbred lines could be used to provide useful estimates of the different types of gene action involved in yield heterosis. The analyses of variance of single or top-cross yield data were a routine procedure. The problem, then, was to find out how such data could be used beyond their original purpose of estimating the significance of differences among mean yields. The hybrid component could be further partitioned into: (1) variation among line means and (2) within-line means or remainder. Such a breakdown was useful, but, after some exploration, we felt this approach did not serve our objective. Our interest was in estimates that could be related to individual lines and that might be indicative of usefulness in selecting parental combinations for the development of new lines.

A new definition of terms was necessary to characterize the estimate obtained. We chose "general" and "specific" combining ability. The variance of general combining ability ($\sigma^2_{\hat{g}}$) could be estimated from the individual-line means when averaged over all combinations involving a given line. General combining ability is primarily a measure of additive effects, which are amenable to selection. The variance of specific combining ability ($\sigma^2_{\hat{s}}$) includes the residue as well as dominance, epistatic, and interaction effects. Several years were to elapse before more precise estimating procedures were developed.[4,5]

The frequency of citation of this paper undoubtedly stems from the fact that it was one of the first to utilize a quantitative genetic concept in plant breeding. The concept of general and specific combining ability has proven useful in subsequent studies.[6]

1. **Wright S.** *The effects of inbreeding and crossbreeding on guinea pigs.* Washington, DC: Government Printing Office, 1922. p. 1-60. USDA Tech. Bull. 1090 and 1121.
2. **Fisher R A.** The correlation between relatives on the supposition of Mendelian inheritance. *Trans. Roy. Soc. Edinburgh* **52**:399-433, 1918.
3. **Lush J L.** *Animal breeding plans.* Ames, IA: Collegiate Press, 1937. 350 p.
4. **Griffing B.** Concept of general and specific combining ability in relation to diallel crossing systems. *Aust. J. Biol. Sci.* 9:463-93, 1956. (Cited 800 times.)
5. **Comstock R E & Robinson H F.** The components of genetic variance in populations of biparental progenies and their use in estimating the average degree of dominance. *Biometrics* 4:254-66, 1948. (Cited 135 times since 1955.)
6. **Hallauer A R & Miranda Fo J B.** *Quantitative genetics in maize breeding.* Ames, IA: Iowa State University Press, 1981. 468 p.

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