20 COMBINING ABILITY

☞ INTRODUCTION

The concept of combining ability as a measure of gene action was proposed by Sprague and Tatum in 1942 working on maize. Combining ability refers to the capacity or ability of a genotype to transmit superior performance to its crosses. The value of an inbred line depends on its ability to produce superior hybrids in combination with other inbreds. The main features of combining ability analysis are given below :

1. Combining ability analysis helps in the evaluation of inbreds in terms of their genetic value, and in the selection of suitable parents for hybridization. It also helps in the identification of superior cross combinations.
2. For combining ability analysis, cross have to be made either in diallel or partial diallel or line × tester fashion.
3. Combining ability analysis helps in the identification of superior hybrid combinations which may be utilized for commercial exploitation of heterosis.
4. Combining ability analysis is a useful tool in the development of synthetic varieties.
5. Combining ability estimates are free from genetic assumtions and are based on empirical results (Simmonds, 1979).

6. Combining ability estimates of *gca* and *sca* effects are based on first order statistics (mean values) and hence are statistically robust.
7. Combining ability analysis provides information about the gene action involved in the expression of various quantitative characters and thus helps in deciding the breeding procedure for genetic improvement of such traits.

☞ TYPES OF COMBINING ABILITY

There are two types of combining ability, *viz.*, general combining ability (*gca*) and specific combining ability (*sca*). A brief description of each type is given below :

General Combining Ability

The average performance of a strain or genotype in a series of hybrid combinations is termed as general combining ability. It is estimated from half-sib families. In other words, the crosses which have one parent in common are used for the calculation of *gca*. For instance, if the parent p is involved in 15 different crosses, the average performance of these 15 crosses will give an estimate of *gca* for the parent *p*. The main features of *gca* are given below :

1. The *gca* variance is primarily a function of the additive genetic variance, but if epistasis is present *gca* will also include additive × additive type of non-allelic interaction.
2. The *gca* is estimated from half sib families.
3. The *gca* variance has positive correlation with narrow sense heritability.
4. The *gca* helps in the selection of suitable (good general combiners) parents for hybridization.

Specific Combining Ability

The performance of a parent in a specific cross is known as specific combining ability. Thus *sca* refers to the deviation of a particular cross from the general combining ability. For instance, the parent p is involved in 15 different crosses, it may not give good performance in all the crosses. The main features of specific combining ability are briefly presented below :

1. The *sca* variance is mainly a function of dominance variance, but if epistasis is present, it would also include additive × additive, additive x dominance and dominance x dominance types of non-allelic interactions.
2. The *sca* is estimated from full sib families.
3. The *sca* variance has positive association with heterosis or hybrid vigour.
4. The *sca* helps in the identification of superior cross combinations for commercial exploitation of heterosis. The main differences between general combining ability and specific combining ability are given in Table 20.1.

Table 20.1 : Differences Between General Combining Ability and Specific Combining Ability

General combining ability	Specific combining ability
1. It is average performance of a strain in a series of crosses	It refers to the performance of specific cross in relation to *gca*
2. *gca* is due to additive genetic variance and additive× additive epistasis	*sca* is due to dominance genetic variance and all the three types of epistasis
3. It is estimated from half-sib families	It is estimated from full-sib families
4. It helps in the selection of suitable parents for hybridization.	It helps in the identification of superior cross combinations
5. It has relationship with narrow sense heritability.	It has relationship with heterosis