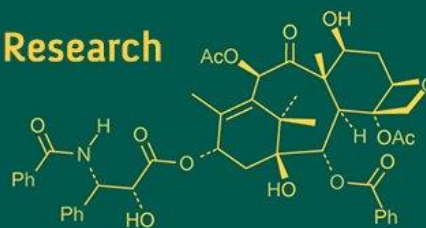


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## Specific combining ability for grain mold resistance in *kharif*-sorghum

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**Abstract**

Grain mold attack has become one of the major constraints hindering sorghum cultivation, which resulted in a drastic decrease in the area of cultivation of *kharif* sorghum. Climate change scenario, cropping pattern and the cultivation of high yielding hybrids and varieties have brought a change in the disease scenario over time, and the disease like grain mold, which were considered minor at some point of time, have become predominant, thereby inducing losses in yield, quality and ultimately reduces the profitability of farmers due to less market value to under quality (blackening) grains. In the present study, ten diverse parents were utilized to assess the potential crosses for grain mold resistance contributing traits using diallel mating design. Desirable significant sca effects in desirable direction for grain mold resistance component traits along with grain yield per plant were found in eight F<sub>1</sub> crosses viz., CSV 27 X GMN 16-3, PDKV Kalyani X AKGMR 117, CSV 34 X AKGMR 117, AKMS 30B X AKGMR 118, PDKV Kalyani X AKGMR 118, GMN 16-3 X AKGMR 118, CSV 34 X B58586, CSV 34 X AKGMR 118 and further evaluation of segregating population of these crosses for grain mold resistance traits and isolation of stable derivatives in advanced generations will be effective for exploitation of grain mold resistance together with grain yield.

**Keywords:** Sorghum, grain mold, SCA effects

**Introduction**

Sorghum [*Sorghum bicolor* (L.) Moench] is one of the major nutri-cereal crop of the world. Sorghum is gaining importance as “health food” now a day, because of its higher dietary fiber, good source of energy, vitamins and minerals including trace elements. But in *kharif* sorghum, grain mold infestation has become one of the major constraints hindering sorghum cultivation, which resulted in a drastic decrease in the area of cultivation. Climate change scenario, cropping pattern and the cultivation of high yielding hybrids and varieties have brought a change in the disease scenario over time, and the disease like grain mold, which were considered minor at some point of time, have become predominant, thereby inducing losses in yield, quality and ultimately reduces the profitability of farmers due to less market value to under quality (blackening) grains.

Several management strategies, such as avoidance, fungicide application, chemical control and adoption of tolerant varieties were tried to control grain mold infection. Among them avoidance or chemical control on farmer's field is impracticable. A grain mold resistance cultivar provides the best means for minimizing the yield losses due to disease epidemic (Prom and Erpelding, 2009, Prom *et al.*, 2014) [4, 5]. This approach is highly recommended in exploring host-plant resistance mechanism. Therefore, major research efforts have been focused on development of resistant cultivars.

Combining ability studies has been becoming increasingly important in breeding as it has proven to be very useful tool for the selection of suitable parents for effective hybridization programme. It gives an idea whether a particular parent combines well in a cross and also denotes specific performance of a cross combination against the expectations from the general combining ability of parents. The present investigation was undertaken to identify the superior cross combinations showing good combining ability for the traits associated with grain mold resistance in *kharif* sorghum.

**Materials and Methods**

The experimental material consisted of ten parents iz., CSV 27, CSV 34, PDKV Kalyani,

RMP-42, AKMS 30B, AKMS 14B, GMN-16-3, AKGMR 117, AKGMR 118, B 58586 and 45 F<sub>1</sub> crosses. These 45 F<sub>1</sub> crosses were developed by crossing ten diverse parents in 10 x 10 half diallel mating design excluding reciprocals. The experiment was conducted in Randomized block design with three replications. The observations were recorded on five competitive plants for threshed grade mold rating (TGMR) [1 to 9 scale], grain hardness, grain density, electrical conductivity of grain leachates, germination percentage, fungal load of *Fusarium* spp., fungal load of *Curvularia* spp. fungal load of other mold spp. and grain yield per plant. The Combining ability analysis based on mean values over replication was carried out for the characters, using method II model 1 of Griffing, 1956.

## Results and Discussion

Combining ability analysis was carried out for all 9 characters of F<sub>1</sub> crosses and presented in Table 1. The variance existing due to treatments was further partitioned using appropriate expectations of the observed mean squares into components of variations attributable to general combining ability (gca) variance and specific combining ability (sca) variance.

The crosses having significant specific combining ability effects in desirable direction for the grain mold resistance contributing traits along with grain yield per plant were sorted out and presented in Table 2.

Among F<sub>1</sub> crosses, eight crosses showed promising desirable sca effects for germination percentage and grain mold resistance traits along with significant sca effects for grain yield per plant. The first promising cross CSV 27 x GMN 16-3 recorded highest significant desirable sca effects for germination percentage along with significant desirable sca effects for threshed grade mold rating (TGMR), grain hardness, grain density, electrical conductivity of grain leachates, fungal load of *Fusarium* spp., fungal load of *Curvularia* spp., fungal load of other mold spp. and grain yield per plant.

The next best cross, PDKV Kalyani x AKGMR 117, recorded significant desirable sca effects for germination percentage, threshed grade mold rating (TGMR), grain hardness, grain density, electrical conductivity of grain leachates, fungal load of *Fusarium* spp., fungal load of *Curvularia* spp., fungal load of other mold spp. along with grain yield per plant.

The third cross CSV 34 x AKGMR 117, exhibited significant desirable sca effects for germination percentage, threshed grade mold rating (TGMR), grain hardness, grain density, electrical conductivity of grain leachates, fungal load of *Fusarium* spp., fungal load of *Curvularia* spp., fungal load of other mold spp. along with grain yield per plant.

The remaining five crosses viz., AKMS 30B x AKGMR 118, PDKV Kalyani x AKGMR 118 GMN 16-3 x AKGMR 118, CSV 34 X B 58586, CSV 34 X AKGMR 118 also showed significant desirable sca effects for germination percentage along with most of the important component characters associated with grain mold resistance and found promising among F<sub>1</sub> crosses.

Hundekar *et al.* (2014) [2] and Ingole *et al.* (2018) [3] reported promising crosses on the basis of SCA effects for grain mold resistance contributing traits and grain yield.

When the performance of all the desirable crosses has been reviewed, estimates of sca effects did not reveal any specific trend among the crosses. It has been observed that these crosses involved parents having all three possible combinations of gca effects i.e., high x high, high x low and low x low. It was also observed that two parents with high gca effects may not necessarily give superior combinations. But highly superior combinations have involved at least one parent of high gca effects. Hence evaluation of segregating population for grain mold resistance traits and isolation of stable derivatives in advanced generations will be effective.

**Table 1:** Analysis of variance for the combining ability of F<sub>1</sub> crosses in 10 x 10 half diallel

| Sr. No | Characters                                         | Sources   |           |       |                |                |                                |
|--------|----------------------------------------------------|-----------|-----------|-------|----------------|----------------|--------------------------------|
|        |                                                    | GCA       | SCA       | Error | $\sigma^2$ gca | $\sigma^2$ sca | $\sigma^2$ gca/ $\sigma^2$ sca |
|        | Degrees of freedom                                 | 9         | 45        | 108   |                |                |                                |
| 1      | Threshed grade mold rating (TGMR) [ 1 to 9 scale]  | 9.313**   | 1.081 **  | 0.106 | 0.767          | 0.975          | 0.787                          |
| 2      | Grain Hardness (kg/cm <sup>2</sup> )               | 3.723**   | 0.624**   | 0.037 | 0.307          | 0.587          | 0.523                          |
| 3      | Grain density (g/ml)                               | 0.042**   | 0.032**   | 0.001 | 0.003          | 0.031          | 0.112                          |
| 4      | Electrical conductivity of grain leachates(ms/ppt) | 0.262**   | 0.037**   | 0.001 | 0.022          | 0.036          | 0.604                          |
| 5      | Germination Percentage                             | 200.942** | 29.607**  | 1.807 | 16.595         | 27.801         | 0.597                          |
| 6      | Fungal load of <i>Fusarium</i> spp. (%)            | 166.724** | 16.772**  | 0.963 | 13.813         | 15.810         | 0.874                          |
| 7      | Fungal load of <i>Curvularia</i> spp. (%)          | 97.953**  | 18.553**  | 0.995 | 8.080          | 17.558         | 0.460                          |
| 8      | Fungal load of other mold spp. (%)                 | 14.390**  | 14.606**  | 0.444 | 1.162          | 14.161         | 0.082                          |
| 9      | Grain yield per plant (g)                          | 714.77 ** | 197.817** | 4.911 | 59.155         | 192.906        | 0.307                          |
|        | ** Significant at 1% level                         |           |           |       |                |                |                                |

**Table 2:** Superior combinations showing significant SCA effects for germination percentage and grain mold resistance traits along with grain yield per plant in F<sub>1</sub> crosses.

| S. N | crosses                  | Significant SCA effects in desirable direction |                                               |                                      |                      |                                |                                         |                                           |                                    |                           |
|------|--------------------------|------------------------------------------------|-----------------------------------------------|--------------------------------------|----------------------|--------------------------------|-----------------------------------------|-------------------------------------------|------------------------------------|---------------------------|
|      |                          | Germination percentage                         | Threshed grade mold rating TGM (1 to 9 scale) | Grain hardness (kg/cm <sup>2</sup> ) | Grain density (g/ml) | EC of grain leachates (ms/ppt) | Fungal load of <i>Fusarium</i> spp. (%) | Fungal load of <i>Curvularia</i> spp. (%) | Fungal load of other mold spp. (%) | Grain yield Per plant (g) |
| 1    | CSV 27 X GMN 16-3        | 10.949**                                       | -1.424**                                      | 0.770**                              | 0.116**              | -0.374**                       | -9.722**                                | -8.278**                                  | -4.120**                           | 21.216**                  |
| 2    | PDKV Kalyani X AKGMR 117 | 9.892**                                        | -1.146**                                      | 0.855**                              | 0.317**              | -0.210**                       | -3.947**                                | -4.527**                                  | -5.711**                           | 13.672**                  |
| 3    | CSV 34 X AKGMR 117       | 8.893**                                        | -1.646**                                      | 1.383**                              | 0.267**              | -0.267**                       | -5.213**                                | -5.066**                                  | -3.192**                           | 24.880**                  |
| 4    | AKMS 30B X AKGMR 118     | 7.617**                                        | -1.341**                                      | 0.799**                              | 0.254**              | -0.259**                       | -7.485**                                | -0.256                                    | -1.496*                            | 10.372**                  |
| 5    | PDKV Kalyani X AKGMR 118 | 7.190**                                        | -0.258                                        | 0.447*                               | 0.348**              | -0.134**                       | -2.413*                                 | -5.659**                                  | -1.429**                           | 9.041**                   |
| 6    | GMN 16-3 X AKGMR 118     | 6.607**                                        | -1.091**                                      | 0.854**                              | 0.326**              | -0.130**                       | -3.890**                                | -4.793**                                  | -3.890**                           | 26.003**                  |
| 7    | CSV 34 X B58586          | 6.550**                                        | -1.008**                                      | 0.605**                              | 0.263**              | -0.198**                       | -5.293**                                | -3.271**                                  | -0.255                             | 19.994**                  |
| 8    | CSV 34 X AKGMR 118       | 6.288**                                        | -1.091**                                      | 1.074**                              | 0.098**              | -0.197**                       | -4.149**                                | -4.282**                                  | -1.926**                           | 12.350**                  |
|      |                          |                                                |                                               |                                      |                      |                                |                                         |                                           |                                    |                           |
|      | CD Sij at 5%             | 2.495                                          | 0.605                                         | 0.357                                | 0.067                | 0.066                          | 1.821                                   | 1.852                                     | 1.238                              | 4.114                     |
|      | CD Sij at 1%             | 3.334                                          | 0.808                                         | 0.476                                | 0.090                | 0.088                          | 2.433                                   | 2.474                                     | 1.653                              | 5.496                     |
|      | CD (Sij-Sik) at 5%       | 3.668                                          | 0.889                                         | 0.524                                | 0.099                | 0.097                          | 2.677                                   | 2.722                                     | 1.819                              | 6.047                     |
|      | CD (Sij-Sik) at 1%       | 4.900                                          | 1.187                                         | 0.700                                | 0.132                | 0.130                          | 3.577                                   | 3.636                                     | 2.430                              | 8.078                     |

**Note:** \* Significant at 5% level and \*\* Significant at 1% level and others are non-significant.

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