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Graphical analysis for yield and yield attributing traits in brinjal (*solanum melongena* l.)

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Abstract
In a study carried out with ten diverse genotypes of brinjal (*Solanum melongena* L.) and forty five F_1 crosses generated from them through 10 x 10 diallel mating design, it was found that a lot of diversity was present with respect to all the traits as depicted by scattered positions of parental arrays in the Wr-Vr graphs. The regression line intersecting the Wr axis below the origin for all the traits indicated over dominance. Position of the parental arrays on the graphs indicated the importance of both dominant and recessive alleles for different traits.

Keywords: *Solanum melongena* L., Diallel, Graphical analysis.

Introduction
Diallel analysis helps in understanding the genetic control of the trait, which guides the breeder to advance and select segregating populations (Vencovsky and Barriga, 1992; Ramalho *et al.*, 1993; Cruz and Regazzi, 1994) [12, 8, 3]. There are several approaches available for analysis of diallel crosses but the two main approaches being followed are Griffing's and Hayman's approaches. These two approaches are often used together for complementary data interpretation. The analysis (either one or both) has been used successfully by various scientists in brinjal (Biswajit *et al*., 2004) [2] and in peppers (Baseerat *et al*., 2013) [1].
For carrying out the combining ability analysis and genetic component analysis, it is assumed that an additive dominance model with additive environmental effects and independence of genes (i.e., absence of epistasis) exists while making the diallel set of crosses. To test the validity of the assumption, relation between the variance (Vr) and parent off-spring covariance (Wr) of the same array and linear regression coefficient of Wr on Vr over arrays provides adequate means. The Wr, Vr statistic provides an estimate of the relative number of dominance to recessive genes present in the common arrays of the parents, with the Wr and Vr statistics, calculated from diallel tables, graphs can be drawn and the geometric representation of these statistics can be interpreted. The position of the regression line in the graph indicates the degree of dominance and we can construct parabola limits in this graph. The interpretation of the results of this analysis is easy and straight forward if the main assumptions of the diallel analysis are fulfilled.

Material and Methods
The experimental materials for the present investigation consisted of ten diverse parental lines viz., Pusa Purple Cluster (P1), Arka Nidhi (P2), Pusa Kranti (P3), SBPL-27 (P4), Arka Kusumakar (P5), SBW-11 (P6), GBL-1 (P7), GOB-1(P8), Pusa Purple Long (P9) and Local Long (P10) crossed in a diallel fashion during *Kharif* 2011 and 45 cross combinations were generated as per method II and Model-I (Griffing 4 & 5). The parents and F_1 crosses were evaluated in randomized complete block design with three replications at each of the three different locations viz., Vegetable Experimental Farm, Division of Vegetable Science, SKUAST-Kashmir, Shalimar (E_1), Regional Research Station and Faculty of Agriculture, Wadura (E_2) and Mountain Research Center for Field Crops, Khudwani, Anantnag (E_3). Recommended package of practices were adopted to raise a healthy crop at all the locations. The observations were recorded on days to first flowering, days to first fruit set, days to first fruit picking, plant height (cm), plant spread (cm), number of branches plant^{-1}, fruit length (cm), fruit diameter (cm), number of fruits plant^{-1}, average fruit weight (g), fruit yield plant^{-1} (kg), fruit yield (q ha^{-1}). The data thus generated, was subjected to standard statistical procedures to generate the results.

Results and Discussion

The pooled Wr-Vr graphs are presented in figures 1-16. The graphical analysis is discussed as under:

1.1 Days to first flowering

The position of parental arrays in the graph were scattered suggesting genetic diversity among the parents for this trait. The graphical analysis revealed that the regression line was intersecting the Wr axis below the origin (Fig. 1). The position of parents on the graph indicated importance of both dominance and recessive alleles for the inheritance of this trait. In pooled data over environments parents Pusa Purple Cluster, Arka Nidhi, Pusa Kranti, Arka Kusumakar and GBL-1 were having more of the dominant alleles as indicated by the parental order of dominance, whereas GOB-1 and Pusa Purple Long revealed more of the recessive alleles. Parents SBPL-27, SBW-11 and Pusa Purple Cluster showed nearly equal effect of both dominant and recessive alleles.

1.2 Days to first fruit set

The position of parental arrays in the graph were scattered suggesting genetic diversity among the parents for this trait. The graphical analysis revealed that the regression line was intersecting the Wr axis below the point of origin suggesting over dominance for this trait (Fig. 2). The position of parents on the graph indicated importance of both dominance and recessive alleles for the inheritance of this trait. In pooled over environments, parents Pusa Kranti, SBPL-27 and GBL-1 were having more of the dominant alleles as indicated by the parental order of dominance, whereas Arka Kusumakar, SBW-11, GOB-1, Pusa Purple Long and Pusa Purple Cluster revealed more of the recessive alleles. Parents Pusa Purple Cluster and Arka Nidhi showed nearly equal effect of both dominant and recessive alleles.

1.3 Days to first fruit harvest

The position of parental arrays in the graph were scattered suggesting genetic diversity among the parents for this trait. The graphical analysis revealed that the regression line was intersecting the Wr axis below the point of origin suggesting over dominance for this trait (Fig. 3). The position of parents on the graph indicated importance of both dominance and recessive alleles for the inheritance of this trait. In pooled data over environments, parents Pusa Purple Cluster, Pusa Kranti, SBPL-27 and GBL-1 were having more of the dominant alleles as indicated by the parental order of dominance, whereas Pusa Purple Cluster revealed more of the recessive alleles. Parents Arka Nidhi, Arka Kusumakar, SBW-11, GOB-1, Pusa Purple Long and Pusa Purple Cluster showed nearly equal effect of both dominant and recessive alleles.

1.4 Plant height

The position of parental arrays in the graph were scattered suggesting genetic diversity among the parents for this trait. The graphical analysis revealed that the regression line was intersecting the Wr axis below the point of origin suggesting overl dominance for this trait (Fig. 4). The position of parents on the graph indicated importance of both dominance and recessive alleles for the inheritance of this trait. Parents showing more of the dominant alleles were observed for Pusa Purple Cluster, Pusa Kranti, Arka Kusumakar, SBW-11, GBL-1 and GOB-1 whereas Arka Nidhi and Pusa Purple Long revealed more of the recessive alleles. Parents SBPL-27 and Pusa Purple Cluster showed nearly equal effect of both dominant and recessive alleles.

1.5 Plant spread

The position of parental arrays in the graph were scattered in all the environments as well as data pooled over environments suggesting genetic diversity among the parents for this trait. The graphical analysis revealed that the regression line was intersecting the Wr axis below the point of origin suggesting over dominance for this trait (Fig. 5). The position of parents on the graph indicated importance of both dominance and recessive alleles for the inheritance of this trait. In pooled data over environments, parents Pusa Purple Cluster, Arka Nidhi, Pusa Kranti, GBL-1 and GOB-1 were having more of the dominant alleles as indicated by the parental order of dominance, whereas SBPL-27, Arka Kusumakar, Pusa Purple Long and Pusa Purple Cluster revealed more of the recessive alleles. SBW-11 showed nearly equal effect of both dominant and recessive alleles.

1.6 Number of branches per plant

The position of parental arrays in the graph were scattered suggesting genetic diversity among the parents for this trait. The graphical analysis revealed that the regression line was intersecting the Wr axis below the point of origin suggesting over dominance for this trait (Fig. 6). The position of parents on the graph indicated importance of both dominance and recessive alleles for the inheritance of this trait. Parents showing more of the dominant alleles were observed for Arka Kusumakar and Pusa Purple Long ; parents Pusa Purple Cluster and Pusa Purple Cluster revealed more of the recessive alleles; whereas Arka Nidhi, Pusa Kranti, SBPL-27, SBW-11, GBL-1 and GOB-1 revealed equal importance of both dominant and recessive alleles.

1.7 Fruit length

The position of parental arrays in the graph were scattered suggesting genetic diversity among the parents for this trait. The graphical analysis revealed that the regression line was intersecting the Wr axis below the point of origin suggesting over dominance for this trait (Fig. 7). The position of parents on the graph indicated importance of both dominance and recessive alleles for the inheritance of this trait. In pooled data over environments, parents Pusa Purple Cluster, Arka Nidhi, Pusa Kranti, SBPL-27, SBW-11, GOB-1 and Pusa Purple Cluster were having more of the dominant alleles as indicated by the parental order of dominance, whereas GBL-1 and Pusa Purple Long revealed more of the recessive alleles. Arka Kusumakar showed nearly equal effect of both dominant and recessive alleles.

1.8 Fruit diameter

The position of parental arrays in the graph were scattered suggesting genetic diversity among the parents for this trait. The graphical analysis revealed that the regression line was intersecting the Wr axis below the point of origin suggesting over dominance for this trait (Fig. 8). The position of parents on the graph indicated importance of both dominance and recessive alleles for the inheritance of this trait. In pooled data over environments, parent Arka Kusumakar was having more of the dominant alleles as indicated by the parental order of dominance, whereas Arka Nidhi, Pusa Kranti, SBPL-27 and GBL-1 revealed more of the recessive alleles. Pusa Purple Cluster, SBW-11, GOB-1, Pusa Purple Long and Pusa Purple Cluster showed nearly equal effect of both dominant and recessive alleles.

1.9 Average fruit weight

The position of parental arrays in the graph were scattered suggesting genetic diversity among the parents for this trait. The graphical analysis revealed that the regression line was intersecting the Wr axis below the point of origin suggesting over dominance for this trait (Fig. 9). The position of parents on the graph indicated importance of both dominance and recessive alleles for the inheritance of this trait. In pooled data over environments, parents Pusa Purple Cluster, Arka Nidhi, Pusa Kranti, SBW-11, GBL-1 and Pusa Purple Long were having more of the dominant alleles as indicated by the parental order of dominance, whereas SBPL-27 revealed more of the recessive alleles. Arka Kusumakar, GOB-1 and Pusa Purple Cluster showed nearly equal effect of both dominant and recessive alleles.

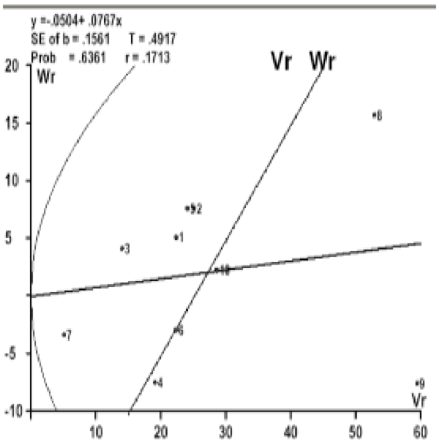
1.10 Number of fruits per plant

The position of parental arrays in the graph were scattered suggesting genetic diversity among the parents for this trait. The graphical analysis revealed that the regression line was intersecting the Wr axis below the point of origin suggesting over dominance for this trait (Fig. 10). The position of parents on the graph indicated importance of both dominance and recessive alleles for the inheritance of this trait. In pooled data over environments, parents Pusa Purple Cluster, Arka Nidhi, Pusa Kranti, SBPL-27, SBW-11, GOB-1 and Pusa Purple Cluster were having more of the dominant alleles as indicated by the parental order of dominance, whereas GBL-1 and Pusa Purple Long revealed more of the recessive alleles. Arka Kusumakar showed nearly equal effect of both dominant and recessive alleles.

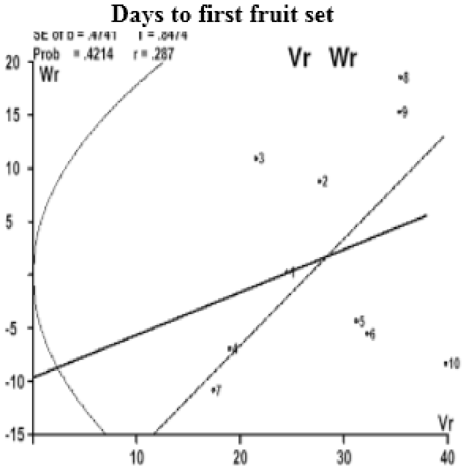
1.11 Fruit yield per plant

The position of parental arrays in the graph were scattered suggesting genetic diversity among the parents for this trait. The graphical analysis revealed that the regression line was intersecting the Wr axis below the point of origin in E_1 and E_2 suggesting over dominance for this trait (Fig. 12). The position of parents on the graph indicated importance of both dominance and recessive alleles for the inheritance of this trait. Parents showing more of the dominant alleles were observed for Pusa Purple Cluster, Arka Nidhi, Pusa Kranti, SBPL-27, Arka Kusumakar, SBW-11 and Pusa Purple Cluster whereas parents GBL-1 and Pusa Purple Long revealed more of the recessive alleles. None of the parents revealed equal importance of both dominant and recessive alleles. Similar results have also been reported in brinjal (Biswajit *et al.*, 2004) [2], in peppers (Sousa and Maluf, 2003; Geleta *et al.*, 2006; Sujiprihati *et al.*, 2007; Rego *et al.*, 2009; Kamble *et al.*, 2009; Grajales *et al.*, 2009; Daryanto *et al.*, 2010; Baseerat et al., 2013) [10, 5, 11, 9, 7, 6, 4, 1].

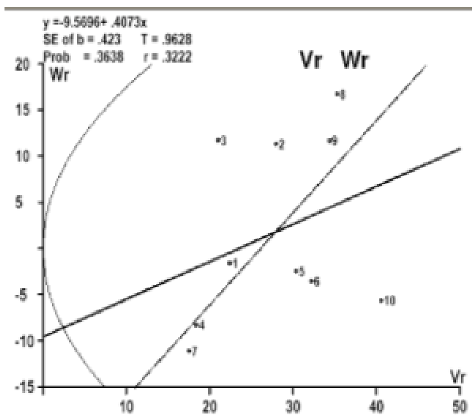
Days to first flowering



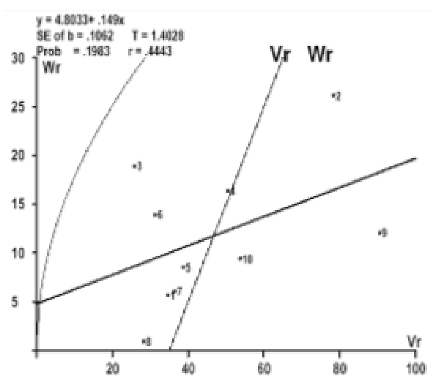
Days to first fruit set



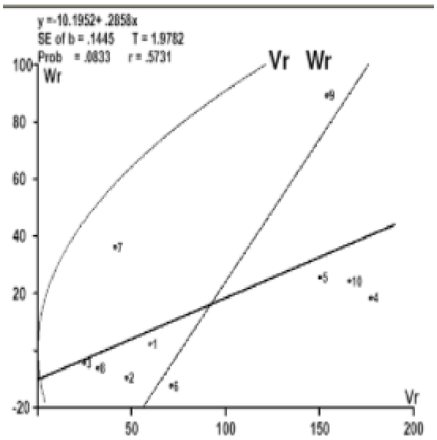
Days to first fruit pickng



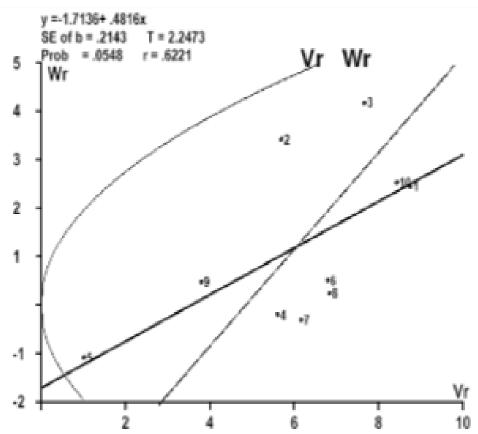
Plant height (cm)

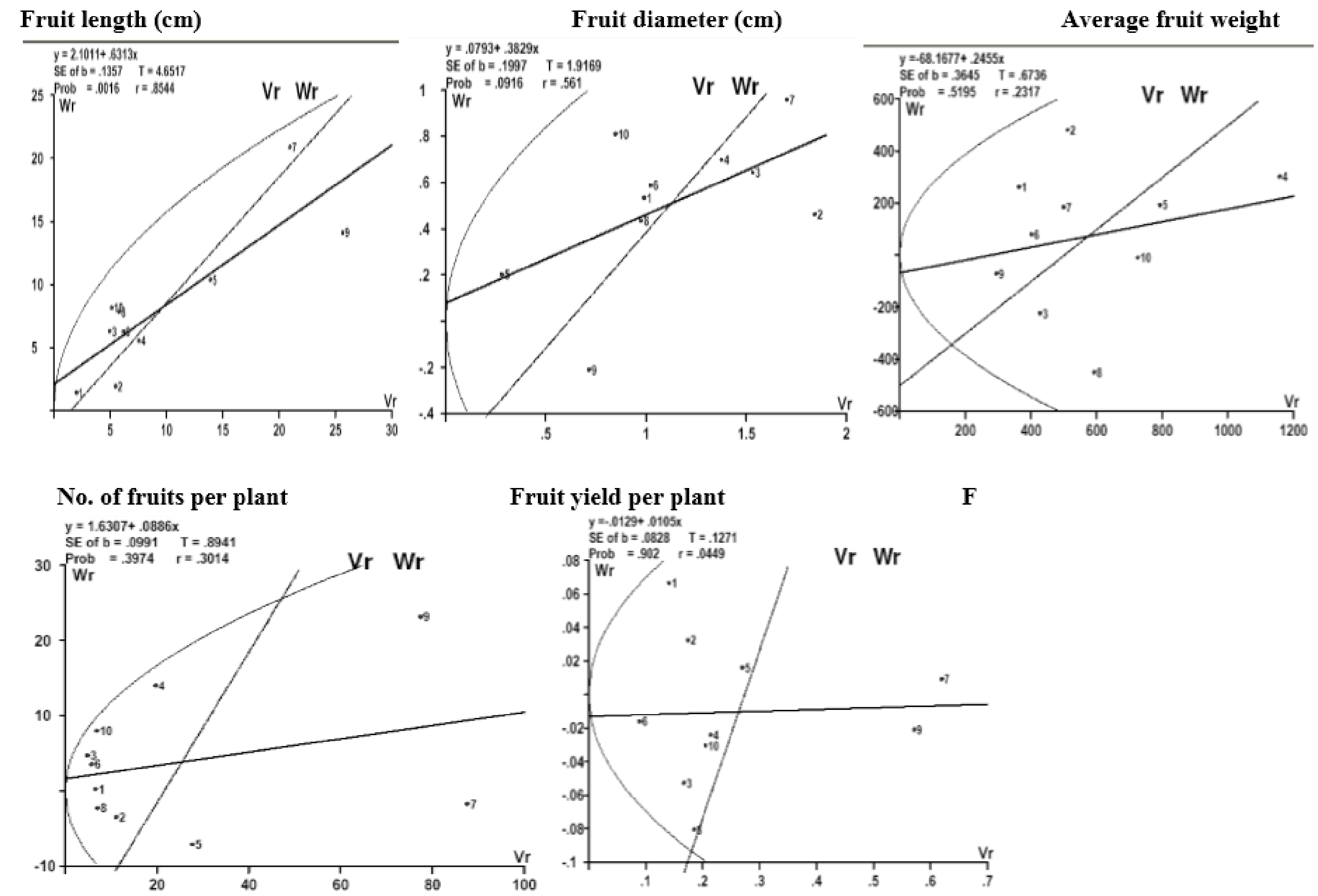


Plant spread (cm)



Number of branches per plant





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