Analysis of combining ability and heterosis in tomato (*solanum lycopersicum)* using full diallel cross

R.G.Y.H.Jayarathna, L.M.H.RAlwis.
Faculty of Animal Science and Export Agriculture, Uva Wellassa University of Sri Lanka

and

H.HemalFonseka, H.M.V.T.Welegama
Horticultural Crop Research and Development Institute, Gannoruwa, Sri Lanka

Introduction

Tomato (Solanumlycopersicum) is the second most important vegetable crop next to potato. Tomato being one of the popular vegetable crops in Sri Lanka is preferred by farmers due to high economic returns, export potentials and nutritive value. Tomato is a rich source of vitamin A, C and minerals like Ca, P and Fe (Dhaliwalet al., 2003). Tomatoes are major contributors of antioxidants such as carotenoids (especially, lycopene and β-carotene), phenolics, ascorbic acid (vitamin C) and small amounts of vitamin E in daily diets (Raiet al., 2012).

In Sri Lanka, tomato is cultivated in more than 7137 ha, producing nearly 73917 t/year. (Department of Agriculture, 2010) The record lower yields are attributed to multiple of factors inclusive of elevated and frequent incidences of pest and diseases and inadequate accessibility to quality seeds (Ceylon Chamber of Commerce, 2011).

Most improvement programmes of many crops use diallel analyses as they provide breeders information on the genetic value of varieties as parents and to assess the gene action which can be directed at improving yield and other related quantitative characters (Vianaet al., 2001). Therefore, an understanding of the genetic control of characters and role of non-allelic interaction is essential to the breeder when deciding of the selection method and breeding procedure to follow (Esmail, 2007). From diallel analysis, plant breeders are able to gather information on heterosis and effect due to maternal, General Combining Ability (GCA) and Specific Combining Ability (SCA) of parents in crosses (Glover et al., 2005).

Materials and method

Parents were obtained from the germplasm of the Plant Genetic Resource Centre (PGRC), Gannoruwa, Peradeniya.Seeds of the all possible crosses, reciprocals and Bhathiya were obtained from the Horticultural Crop Research and Development Institute (HoRDI), Gannoruwa from the maha season 2013/2014. All possible crosses and parents were shown in table 01.

Table 01: Table of diallel analysis

M \ F	PH 12561	PH 12585	PH 12696	PH 12835
PH 12561		PH 12585 X PH 12561	PH 12696 X PH 12561	PH 12835 X PH 12561
PH 12585	PH 12561 X PH 12585		PH 12696 X PH 12585	PH 12835 X PH 12585
PH 12696	PH 12561 X PH 12696	PH 12585 X PH 12696		PH 12835 X PH 12696
PH 12835	PH 12561 X PH 12835	PH 12585 X PH 12835	PH 12696 X PH 12835	

These experiments included four parents, twelve F1 hybrid crosses and one reference line as Bhathiya. During the yala seasons of 2014 field experiments were conducted at HoRDI, Gannoruwa, only with total of 294 plants (Parents, F1 hybrids and Bhathiya as reference line).

The experiment was conducted in randomized complete block designs with two replications. All the management practices were done according to the department of agriculture recommendations. Finally fully ripened fruits were harvested.

Minitab 17 (1.0 version) software was used to analyse the variance of the twenty quantitative characters followed by the General linear model at the 0.05 probability level as mean separation technique. Analyzed mean values of the characters showing significant differences were further subjected to the analysis of combining ability by Griffing's (1956) Method, heterosis and heritability calculations.

Data collection

Phenotypically similar five tomato plants were selected from each variety at the seedling stage for data collection. Quantitative data were collected from those selected five plants under the vegetative, reproductive, yield and fruit quality traits for each variety.

Results and discussion

According to study PH 12561 X PH 12835 F_1 hybrid involved poor female into high male general combiner and performing positive specific combining ability with increase vigor of F_1 over the mid parent, better parent and standard variety. Therefore, it expressed as non-additive into additive gene interaction by performing low to moderate narrow sense heritability with slight environmental effect for the vegetative traits and yield traits. Similar results found by Frimpong*et al.*, 2006.

Interpretation of the reproductive traits indicated the PH 12585 X PH 12835 F_1 hybrid involved average female into high male general combiner and executing positive specific combining ability through increase vigor of F_1 over mid parent, better parent and standard variety with

expression of the additive into additive gene interaction by performing low narrow sense heritability with low environmental effect.

In pursue of the research study, PH 12561 X PH 12696 F_1 hybrid elaborated poor female into high male general combiner and performing positive specific combining ability with increase vigor of F_1 over the mid parent, better parent and standard variety. Therefore, it interpreted as non-additive into additive gene interaction by performing low to moderate narrow sense heritability with slight environmental effect for the fruit quality traits.

Most of the considered quantitative traits were slightly affected by the environment due to the estimation of moderate narrow sense heritability values.

Conclusion

In pursue of the research study, PH 12835 parent interpreted as the best open pollinated parent. PH 12561 X PH 12835 F_1 hybrid indicated as the best F_1 hybrid for the vegetative and yield traits. PH 12561 X PH 12696 F_1 hybrid indicated as the best F_1 hybrid for the fruit quality traits.

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