MOLECULAR BREEDING OF HYBRID TOMATOES (*LYCOPERSICON ESCULENTUM* MILL.) FOR DRY ZONE CONDITIONS OF SRI LANKA

BY

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ABSTRACT

The major constraint to expand tomato (*Lycopersicon esculentum* Mill.) cultivation in the dry zone of Sri Lanka is the lack of varieties specifically developed to withstand environmental stresses prevailing in the dry zone, such as water deficit and high temperature. Therefore, the principal objective of this study was to produce new tomato hybrids with greater yield potentials to be used in the dry zone conditions of Sri Lanka. This goal was achieved by assessing physiological and growth parameters in conventional breeding methods combined with molecular testing procedures. Further, molecular marker techniques were used in DNA fingerprinting of parental genotypes, testing the applicability for identification of true hybrids and to assess the relationship between heterosis and genetic distance.

To investigate how tomato yield and some selected physiological and growth parameters are affected by soil water levels, 55 different genotypes, were evaluated under two water regimes. The experiment was carried out in the plant house of the Biotechnology Center, Peradeniya, from January – May 2003. Ten parental tomato varieties (Bianz, T146, CL-9-0-0-1-3, Thilina, Ravi, T245, Vihara, Marglobe, KWR, and Roma) together with their 45 F1 hybrids (crossed according to a half-diallel mating design) were grown under the stress cycles as well as under well-watered conditions. Each genotype contained 4 replicates with 2 water treatments. To impose the water stress, the plants were subjected to 3 stress cycles. At each cycle soil moisture content was allowed to decrease down to -0.07 MPa and followed by re-

watering to saturation. Yield per plant together with physiological parameters and growth parameters were evaluated in stressed and non-stressed plants separately.

A significant ($P<0.0001$) variation between the tomato genotypes was observed under both water regimes as well as a significant ($P<0.0001$) genotype x water regime interaction. Under the water stress cycles, yield was significantly negatively correlated with stomatal conductance; g_s ($P<0.05$), and transpiration rate; T_l ($P<0.001$) indicating the importance of water conservation in determining yield. However, when stress cycles were imposed, root length (RI) and instantaneous transpiration efficiency (ITE) positively significantly ($P<0.05$) influenced the yield. Therefore, to identify higher yielding genotypes under water stress, g_s, T_l and ITE together with RI, could be used as selection criteria.

The field performance of 45 tomato hybrids together with their parents were evaluated at the Field Crop Research and Development Institute (FCRDI), Mahailluppallama, Sri Lanka, during January to May 2004 in order to select suitable hybrids for cultivation under dry zone conditions. ANOVA revealed existence of highly significant ($P<0.0001$) genetic variability between genotypes for all the traits studied except for leaf area (LA). Under the field condition yield was positively correlated with fruit number, percentage fruit set (% FS), number of branches, photosynthesis (P_n), g_s, and T_l while negatively correlated with flowers/cluster indicating the importance of % FS rather than flowers/cluster.

Hayman's analysis revealed significant (P<0.001) additive genetic effect for all the measured parameters except P_n and ψ_{H2O}. On the other hand a significant (P<0.001) dominance genetic effect was observed for all the parameters except LA, water potential (ψ_{H2O}) and chlorophyll content (Chl), indicating the possibility of producing hybrids for most of the yield parameters. Parental-offspring regression line deviated from unit slope, suggesting non-allelic interaction and non-independent gene distribution. Although the intercept was negative for most of the characters, it was not significantly differing from zero, indicating complete dominance for the all the traits. Therefore, although we produced superior hybrids there is also a possibility of producing equally good or superior pure lines.

Griffing's analysis revealed highly significant general combining ability (GCA) and specific combining ability (SCA) for most traits indicating the importance of some parents to increase certain characters as well as superiority of some hybrids. The dominance variance was much higher than the additive variance for most characters indicating the possibility of producing superior hybrids. Significant heterosis over better parent (heterobeltiosis) has been shown to exist in tomato hybrids for yield and yield related traits. No single hybrid was superior for all characters. Therefore, final selection was made using a selection index. Hybrids G11 (Ravi x Bianz), G46 (Roma x T146), G20 (Ravi x T245), G40 (Ravi x KWR) and G13 (Ravi x CL-9-0-0-1-3), were selected as new tomato hybrids with potential for cultivation under dry zone conditions.

Molecular investigations using RAPD and SSR, successfully differentiated the 10 parental cultivars. Nei and Li coefficients indicated low similarities between the dendograms produced by RAPD and SSR analysis. The genetic distances between parental cultivars, scored using SSR markers, were positively, significantly correlated with heterobeltiosis for yield. The microsatellite molecular technique (SSR) was effective in testing true hybrids.