STUDIES ON COMBINING ABILITY OF QUANTITATIVE CHARACTERS IN SOME TOMATO CULTIVARS

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ABSTRACT

A 5 x 5 half diallel cross among some tomato (*Lycopersicon esculentum Mill*) cultivars was investigated with respect to fruit and yield characters. General combining ability(GCA) and specific combining ability (SCA) variance for the arrays and individual cross combination in the studied characters i.e, plant height, percentage of fruit set, fruit weight, fruit diameter, fruit height, early yield and total yield were calculated and discussed. Both GCA and SCA variance were significant for all characters.Apreponderance of variance due to GCA over SCA was observed for percent of fruit set fruit diameter, fruit height and fruit weight characters indicating the importance of additive gene action.While SCA variance was great in plant height,early yield and total yield chracters indicating nonadditive gene action playes important role in inheritance of these chracters.Cultivar Supermarmand prosses high GCA effect in most studied characters,while hybrids Pritchard x Super- marmand,Strain B x Cal Ace and Supermarmand x Cal Ace showed high SCA effect.

INTRODUCTION

Tomato (*Lycopersicon esculentum Mill*) is the main vegetable crop in Egypt for consumption and export. It is very important to know about gene action which involved in the inheritance of the characters and effect of additive and non-additive genetic especially in breeding program. The application of the diallel cross analysis provides the breeder with detailed information after one generation.

Trinklein(1975), studied the combining ability and reciprocal effect for several tomato characters in the parent and F_1 of a diallel cross involving six cultivars. Highly GCA and SCA effect were observed for most of the characters including fruit weight ,early yield and total yield.

El-Ahmadi and Stevens (1979b) in tomato found that recessive gene were associated with high number of flower at both normal and high temperatures. Percentage of fruit set was controlled largly by additive genes.Govindarasu *et al.*(1981) showed that, elevin lines and 44 F_1 hybrids were evaluated for eight characters.Specific combinig ability (SCA) variances were higher than general combinig ability (GCA) variances for plant height, number of laterals,number of fruits per plant, total soluble solids and fruit yield,indicating nonadditive gene action. However, for fruit size and locule number there was a preponderance of additive gene action.Sidhu *et al.*(1981) evaluated seven varieties and their hybrids from a nonreciprocal diallel for nine characters during 1977-78. Estimates of general combinig ability (GCA) were higher than those for specific combining ability (SCA) for all characters except pericarp thickness.High values for both types of combinig ability were found for all characters except acidity and total soluble solids,for GCA and fruit weight and number of fruits/plant for SCA.Nonadditive gene effects were

predominant for total yield/plant , height, number of fruits/plant , number of branches/plant , number of locules/fruit and precicarp thickness, although additive effects were also important.Swamy and Mathai (1982) found that,general and sepicific combinig ability effect were significant for all characters of progeny from diallel crosses aming nine inberd lines.Additive gene action was predominant for early fruit yield/plant, number of fruits/plant and fruit weight.Tarrega and Nuez (1983) presented data on combining ability and genotypic, environmental and phenotypic correlations for four fruit traits in the parental and F_1 generations of a 7×7 half diallel.General and specific combining ability variances were highly significant for fruit length, diameter and lobe number, while only general combining ability was significant for fruit shape.Shalaby *et al*. (1983) investigated a six half-diallel cross among some tomato cultivars with respect to fruit and yield characters. Fruit set, days to the first ripe fruit, early yield, total yield, fruit weight and fruit shape index showed heritable variation.Jamwal *et al.*(1984) presented that,data on fruit yield/plant, fruit number/plant,day to flowering and ascorbic acid content in parents and F_1 of cross between 10 foreign lines and 3 local testers ,together with data on combining ability and hetrosis for these traits.Heterosis was observed for all characters.Lopez-Rivares and Cuartero (1985) showed that data recorded in the F_1, F_2 and backcross generations from an 8-variety diallel cross revealed the partial dominance of a greater number of early fruits and of lower single fruit weight in the early yield, suggesting that, in order to obtain F_1 populations with higher early yields than the parental varieties, a parent which bears a large number of early fruits must be crossed with which bears heavy fruits.

Data are tabulated on combinig ability effects for yield/plant and 8 of its components measured in crosses between 13 lines and 4 testers by Sonone *et al.* (1986).Additive gene action predominated for days to frist flowering, total soluble solids, fruit weight and fruit number, but nonadditive effect were important for yield, height and other characters.Chandrasekhap and Rao (1989) evaluated F_1 progenies and their parental genotypes for GCA and SCA regarding important characters. Significant differences were noted for all the charcters studied and the variations due to GCA and SCA were significant. Hassan *et al.* (1995) reported that studies on combining ability for yield components in seven tomato (*Lycopersicon esculentum*) cultivars and their 21 F_1 hybrids indicated that there were highly significant variances among the genotypes for all the characters studied. Most of the genetic variance was due to additive gene effect. Best general combiners and specific combinations were indicated.Wang *et al.* (1998) in crosses among 5 processing tomato cultivars using complete dialled design of Griffing`s methods 1 indicated that general combining ability (GCA) were highly significant for all analysed traits.

MATERIALS AND METHODS

Five cultivars of tomato Pritchard (P_1), UC97-3 (P_2), Strain B (P_3), Supermarmand (P_4) and Call Ace (P_5) were crossed according to non-

reciprocal diallel pattern. The F_1 hybrids were produced by emasculation and hand pollination during the 1999 season in El-Kaothr Farm Faculty of Agriculture Sohag. Parents and F_1 hybrids were planted in a Randomized Complete Block Design with three replicates on March 10, 2000.Measurments taken were

1-Plant height
2-Percentage of fruit set
3-Fruit weight
4-Fruit diameter
5-Fruit height
6-Early yield
7-Total yield

Data were subjected to the genetic analysis according to Griffing (1956b)Method 4 model 1.

RESULTS AND DISCUSSION

The analysis of variance of both general and sepicific combinig ability are presented in Table(1).The results indicated that,significant of general and sepicific combining ability in all studied characters.These results agree with Trinklein (1975), Swamy and Mathai(1982), Tarrega and Nuez (1983), Sonone *et al.* (1986),Chandrasekhap and Rao (1989) and Wang *et al.* (1998).

The variance due to GCA was much higher than SCA for percent of fruit set , fruit weight ,fruit diameter and fruit height characters.On the other hand,SCA variance was greater than GCA for plant height,early and total yield characters. The same results obtainted from Govindrasu *et al.* (1981), Sidhu *et al.*(1981) and Wang *et al.* (1998).

The calculated values of GCA and SCA effect for the arrays and individual cross combinations in all characters are presented in Table 2 and 3.

a-Plant height

Only parent 4 had significant positive GCA effect for plant height and parent 3 had significantly negative GCA effect for lowest plant height (Table 1). On the other hand, the crosses 1x4 and 4x5 had the maximum effects (tallest plant height).

b-Percentage of fruit set

Parents 4 and 2 showed significant positive GCA effect for percentage of fruit set and parent 4 gave the highest value in this trait. While, parents 1, 3 and 5 showed significant negative GCA effect. The crosses 3x5 and 1x3 were givn the highest and lowest values of SCA effect in this trait respectively.

c-Fruit weight

Parents 4 and 1 showed significant effect for larger fruit weight, while parents 2 , 3 and 5 showed significant GCA effect for smaller fruit weight. The hybrid 4x5 had the maximum SCA effect for greater fruit weight, while hybrid 2x5 had the maximum SCA effect for smaller fruit weight.

d-Fruit diameter

All parents showed non significant GCA effect. Also, all hybrids showed non significant SCA effect for fruit diameter.

e-Fruit height

Parents 2 and 5 showed significant positive GCA effects for fruit height. While, parent 1 had significant negative GCA for this trait. On the other hand, hybrids 1x2 , 1x5 and 4x5 had significant negative SCA effect, while the rest of hybrids had significant positive SCA effect except hybrid 2x5 was not significant.

f-Early yield

Parents 1 and 4 showed significant positive of GCA effect for this trait and the second parent gave the highest value. The rest of parents showed significant negative GCA effect for early yield. The crosses 1x2 , 3x4 and 4x5 had significant negative SCA effect. While, the rest of crosses showed significant positive effect of SCA and cross 3x5 gave the highest value.

g-Total yield

Parent 4 and 5 significantly higher for total yield than other parents in this trait. The crosses 1x5 and 4x5 were significantly higher effect SCA for total yield than other crosses.

From the study of GCA effect for the studied characters found that parent 4 (Supermarmand) posses high GCA effect for most of the studied characters.

Table (1): Analysis of variance of fruit and yield characters of the 5x5 diallel cross.

Characters	d.f	M.square	F. ratio
1-Plant height			
GCA	4	605	1080**
SCA	10	700	1095**
2-Percentage of fruit set			
GCA	4	554.2	1060.4**
SCA	10	40.3	80.5**
3-Fruit weight			
GCA	4	120.5	100.1**
SCA	10	50.5	30.2**
4-Fruit diameter			
GCA	4	60.52	21.20**
SCA	10	52.5	18.22**
5-Fruit height			
GCA	4	0.20	506**
SCA	10	0.014	100**
6-Early yield			
GCA	4	0.30	120.2**
SCA	10	0.45	130.1**
7-Total yield			
GCA	4	0.30	90.4**
SCA	10	0.48	101.2**

*** significant at p=0.05**
**** significant at p=0.01**

Table(2): Estimates of GCA effect of parents for the studied characters.

	Plant hight	Percentage of fruit set	Fruit weight	Fruit diameter	Fruit height	Early yield	Total yield
1	-0.63	-2.25**	2.41**	-0.13	0205**	0.64**	-2.36**
2	0.72	1.25**	-1.95**	-0.11	0.195**	-0.21**	-0.85**
3	3.94**	-2.41**	-8.21**	-0.14	0.071	-0.44	-2.19**
4	3.92**	10.22**	10.14**	0.41	0.091	1.35**	5.41**
5	0.54	-6.81**	-2.39**	-0.04	0.17**	-1.33**	0.26**
S.E (gi-gj)	±0.401	±0.564	±2.39	±0.405	±0.052	±0.046	±0.097

*** significant at p=0.05**
**** significant at p=0.01**

Table 3: SCA effect for individual cross combination in the studied characters of 5x5 half diallel cross.

	Plant hight	Percentage of fruit set	Fruit weight	Fruit diameter	Fruit height	Early yield	Total yield
1x2	4.21**	-7.02**	-2.26**	-0.17	-0.33**	-1.18**	-1.31**
1x3	5.33**	-10.36**	3.52**	0.04	0.25**	0.15**	2.09**
1x4	11.00**	5.62**	-8.40**	0.16	0.21**	1.87**	-2.50**
1x5	-4.31**	-0.62**	2.40**	0.03	-0.24**	0.16**	4.58**
2x3	7.25**	-3.12**	2.41**	-0.23	0.39**	0.32**	2.34**
2x4	-12.25**	0.54	-1.50**	0.25	0.35**	0.26**	1.38**
2x5	9.87**	3.81**	-12.36**	-0.12	0.09	0.51**	2.15**
3x4	5.63**	7.53**	2.56**	-0.04	0.15**	-0.31**	-2.43**
3x5	0.35**	10.60**	8.15**	0.42	0.11*	2.27**	-3.00**
4x5	10.91**	-3.92**	12.68**	-0.06	-1.70**	-2.16	4.31**
S.E.	±0.635	±0.851	±0.730	±0.882	±0.057	±0.061	±0.218

*** significant at p=0.05**
**** significant at p=0.01**

High GCA effect are related to additive genetic effect or additive x additive interaction effects (Griffing 1956 a) which represented the fixable genetic components of variation. Therefore , Parent 4 appeared to be worthy in practical plant breeding. On the other hand, the crosses 3x4 , 3x5 and 4x5 showed high SCA effects in most studied characters, these crosses can be used in different ways since additive and additive x additive effects are of considerable importance.

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دراسات على القدرة الائتلافية للصفات الكمية فى بعض أصناف الطماطم

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أجرى هذا البحث فى قسم البساتين بكلية الزراعة بسوهاج جامعة جنوب الوادى بمزرعة الكلية بالكوثر. واستخدمت فى هذه الدراسة خمسة أصناف من الطماطم هى (برتشارد-يوسى٩٧-٣-سترين بى-سوبر مارمند-كال أيس) وكذلك الهجن الناتجة منها بطريقة التهجين الدائرى فى اتجاه واحد وذلك لدراسة السلوك الوراثى لبعض الصفات الكمية وهى طول النبات،نسبة العقد للثمار،قطرالثمرة،أرتفاع الثمرة،وزن الثمرة،المحصول المبكر و المحصول الكلى.

وأظهرت النتائج المحلله بطريقة جريفينج ما يلى:-

١-كانت كلا من القدرة العامة و الخاصة على التالف معنوية فى كل الصفات المدروسة.

٢-كانت الأختلافات الناتجة عن القدرة العامة على التالف أكبر من الناتجة عن القدرة الخاصة على التالف فى صفات نسبة عقد الثمار،قطر الثمرة،أرتفاع الثمرة ووزن الثمرة دليل على أهمية فعل الجين المضيف فى وراثة هذه الصفات.

٣-كانت الأختلافات الناتجة عن القدرة الخاصة على التالف أكبر من الناتجة عن القدرة العامة على التالف فى صفات طول النبات ،المحصول المبكر والمحصول الكلى دليل على أهمية فعل الجين الغير مضيف الذى يلعب دورا مؤثرا فى وراثة هذه الصفات.

٤-أظهر الصنف سوبر مارمند قدرة ائتلافية عالية فى معظم الصفات المدروسة بينما كانت الهجن (برتشارد x سوبر مارمند) ،(سترين بى x كال أيس) و (سوبر مارمند x كال أيس) تمتلك أكبر قدر من القدرة الائتلافية الخاصة فى الصفات المدروسة.