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Specific Combining Ability of Ornamental Peppers (*Capsicum annuum* L.)

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ABSTRACT

Ornamental pepper single cross varieties are required because of their high yield and high quality. Production of single cross requires superior parental lines. This study was conducted to screen for parental lines of which could be used for the production of superior single cross. The 11 female parental lines (No. 1, 2, 3, 4, 14, 53, 62, 67, 79, 80 and 81) were topcrossed to a tester (No. 77). All 11 single crosses and the parental lines were tested at Horticultural experimental field, Kasetsart University, Bangkhen Campus, Bangkok from August 2000 to February 2002, using a Completely Randomized Design with 4 replications. Six characteristics were evaluated. The results showed the significant differences in 6 characteristics. All hybrids showed the average percent of heterosis over mid parent and better parent for yield per plant. The hybrids No. 1 X 7, 3 X 77, 4 X 77, 14 X 77, 53 X 77, 62 X 77 and 67 X 77 had the highest heterosis of number of fruits per plant and fruit weight per plant. The selected female parental lines, based on their specific combining ability, were No. 1, 3, 4, 14, 53, 62 and 67. They may be used as the female parental lines with their counterpart male tester for commercial hybrid production. The relationships among the characteristics were observed and the canopy size was positively correlated with number of fruits per plant and fruit weight per plant. The fruit size was positively correlated with fruit weight per plant and negatively correlated with number of fruits per plant.

Key words: ornamental peppers, single cross, heterosis, specific combining ability, correlation

INTRODUCTION

Peppers are an important part of Thailand economy. There is a plethora of magnificent colors and shapes of peppers grown worldwide, and uses for these peppers are as diverse as the fruit types in the *Capsicum* genus. Pepper fruit is consumed as a fresh vegetable or dehydrated for use as a spice. By volume, red pepper products, pungent and non-pungent, represent one of the most important spice commodities in the world. They add spice flavoring and color to foods while providing essential vitamins and minerals. Pepper extracts are also used in pharmaceutical and cosmetic products. In addition to their use as food, condiment and medicine, peppers are also used as ornamental in gardens (Bosland and Votava,1999).

Ornamental peppers have long been grown as a bedding plant and also used as a potted plant for interior decor (Armitage,1989). Ornamental peppers as potted plants are popular in Europe and are gaining in popularity in the United States (Bosland *et al*., 1994). Merits of ornamental peppers as a potted plant include easy seed propagation, relatively short cropping time, heat and drought tolerance. The fruits of some ornamental peppers

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are pungent and similar to chilli, they can be used as both potted plants for decoration or consumed with food.

The single cross varieties of ornamental peppers are desirable because of their yielding and high quality. Particularly, the single cross with uniform plant type and possessed heterosis in terms of yield, hybrid vigor, diseases and pests resistance (Greenleaf, 1986). Production of single cross require superior parental lines. This research was therefore, conducted to study the specific combining ability (SCA), heterosis and correlation of yield and yield components of experimental lines of ornamental peppers, in order to screen for parental lines with good combining ability for the production of superior single crosses.

MATERIALS AND METHODS

All the experiments under this study were conducted at Horticulture experimental field, Kasetsart University, Bangkhen Campus, Bangkok during August 2000 to February 2002.

Seeds of 83 ornamental pepper lines were collected domestically as well as from outside Thailand. The derived seeds were sown and transplanted to plastic pots. All lines were selfed and the uniform and high yield lines (No. 1, 2, 3, 4, 14, 53, 62, 67, 79, 80 and 81) and tester (No. 77) were selected and seeds were harvested at ripened stage. The derived selfed seeds were planted and topcrossed to tester to verify their specific combining ability (SCA).

The 11 single crosses and 12 parental lines were grown in a Completely Randomized Design with 4 replications. Characteristics under study were recorded at 105 days after planting for plant height and canopy width, and at 120 days for fruit length, fruit width, number of fruits per plant and fruit weight per plant.

Data were analyzed using SAS program and means were separated using Duncan's New Multiple Range Test. Heterosis percentage were calculated using the following formula : heterosis = $[(F_1 - MP)/MP]*100$ and heterobeltiosis = $[(F_1 - HP)/HP]*100$ (MP : mid parent and HP : high parent). Correlation coefficient was used to verify the relationship among the characteristics.

RESULTS AND DISCUSSION

1. Studies of 6 characteristics of 11 tested-hybrid and their counterpart parents

Analysis of variances revealed highly significant difference among 11 tested-hybrids and their counterpart parents for all 6 characteristics. At the age of 105 days, the tallest hybrids were No. 80 x 77 and 3 x 77 (18.84 and 18.58 cm, respectively) while the shortest hybrid was No. 62 x 77 (13.79 cm) and the widest canopy (46.40 cm) hybrid was No. 62 x 77 (table 1).

Table 1 showed also the difference of fruit characteristics at the age of 120 days. The longest fruit (4.28 cm) hybrid was No. 53 x 77 while the shortest (1.36 cm) and widest fruit (1.09 cm) hybrid was No. 80 x 77. The hybrid No. 3 x 77 had the highest number of fruits (301.38 fruits) and fruit weight per plant (120 g).

2. Heterosis

The heterosis and heterobeltiosis percentage for number of fruits per plant of 11 tested -hybrids were ranged from 57.66 % to 173.68 % and 26.56 % to 129.97 %, respectively. The hybrids No. 3 X 77, 67 X 77, 1 X 77 and 4 X 77 had high heterosis at 173.68 %, 132.32 %, 119.05 % and 108.29 %, respectively. The tested-hybrids No. 3 X 77, 4 X 77 and 14 X 77 had high heterobeltiosis at 129.97 %, 107.65 % and 96.61 %, respectively (Table 2)

The heterosis and heterobeltiosis percentage for fruit weight per plant of tested-hybrids were ranged from 82.31 % to 273.34 % and 14.66 % to 267.34 %, respectively. The hybrids No. 1 X 77, 3 X 77, 14 X 77 and 62 X 77 had high heterosis at 272.34 %, 202.89 %, 175.58 % and 160.54 %, respectively. The hybrids No. 1 X 77, 3 X 77, 62

Table 1 Means of plant height, canopy width, fruit size, number of fruits per plant and fruit weight per plant of 11 tested-hybrids and their counterpart parents.

Line		Plant height[1/]	Canopy width[1/]	Fruit length[1/]	Fruit width[1/]	Number of fruits/plant[1/]	Fruit weight/ plant[1/]
Parent	77	14.72 m	31.88 g	2.29 j	0.55 m	131.05 j	28.29 n
	1	25.92 a	27.88 h	3.43 e	1.04 d	46.55 n	27.53 n
	2	17.18 ij	27.91 h	5.08 b	1.30 b	43.70 n	66.93 i
	3	20.34 c	28.49 gh	2.32 j	1.10 c	89.18 l	56.22 k
	4	24.15 b	40.69 cd	2.16 k	0.77 hij	130.25 j	42.45 m
	14	20.60 c	38.38 e	1.96 l	0.96 e	118.55 k	48.12 l
	53	19.19 d	30.00 g	5.19 a	0.77 hij	116.33 k	94.08 e
	62	10.47 o	29.81 g	2.25 jk	1.04 d	81.63 lm	41.54 m
	67	18.48 ef	25.59 i	2.52 i	0.95 e	80.30 m	102.30 d
	79	16.28 k	38.06 e	1.50 m	0.73 jk	216.92 f	57.44 k
	80	20.44 c	42.04 c	1.31 n	1.36 a	135.42 j	68.08 i
	81	17.06 j	33.04 f	2.17 k	1.07 cd	117.90 k	62.43 j
Tested-hybrid							
	1 x 77	18.19 fg	39.76 de	3.42 e	0.82v fg	194.52 g	103.92 d
	2 x 77	16.17 k	41.38 cd	4.16 d	0.84 f	165.86 i	111.22 c
	3 x 77	18.58 ef	40.96 cd	3.14 f	0.82 fg	301.38 a	128.00 a
	4 x 77	17.91 gh	40.34 cd	2.54 i	0.65 l	272.13 c	82.52 g
	14 x 77	17.26 ij	39.83 de	2.15 k	0.76 jk	257.66 d	105.30 d
	53 x 77	17.90 gh	43.99 b	4.28 c	0.64 l	244.48 e	113.90 c
	62 x 77	13.79 n	46.40 a	2.95 h	0.79 ghi	183.80 h	90.98 ef
	67 x 77	17.60 hi	44.10 b	3.06 fg	0.74 jk	245.54 e	119.05 b
	79 x 77	15.24 l	40.76 cd	2.22 jk	0.72 k	286.24 b	88.96 f
	80 x 77	18.84 de	40.92 cd	1.36 n	1.09 c	210.07 f	78.06 h
	81 x 77	17.02 j	43.75 b	2.97 gh	0.92 e	239.57 f	117.76 b
F-test		**	**	**	**	**	**
CV (%)		1.84	3.13	2.44	3.51	3.51	3.27

[1/] Means in a column followed by the same letter are not significant difference at 5% level according to Duncan's New Multiple Range Test

** Significant at $P \leq 0.01$

X 77 and 14 X 77 had high heterobeltiosis at 267.34 %, 127.68 %, 119.02 % and 118.39 %, respectively (Table 3). These results are in conformity with the findings of Kaul and Shama (1988); Milerue and Nikornpun (1999); Sukwiwat and Nikornpun (2001).

3. Correlation among various characteristics

The relationship among the characteristics showed that plant height was positively correlated with fruit length, fruit width, number of fruits per plant and fruit weight per plant. The canopy width was highly and positively correlated with number

Table 2 Heterosis and heterobeltiosis percentage for number of fruits per plant of 11 tested-hybrids and fruits per plant means of their counterpart parents.

Hybrid	Number of fruits per plant				Heterosis (%)	Heterobeltiosis (%)
	P_1	P_2	MP	F_1		
1 X 77	46.55	131.05	88.80	194.52	119.05**	48.43**
2 X 77	43.7	131.05	87.38	165.86	89.81**	26.56**
3 X 77	89.18	131.05	110.12	301.38	173.68**	129.97**
4 X 77	130.25	131.05	130.65	272.13	108.29**	107.65**
14 X 77	118.55	131.05	124.80	257.66	106.46**	96.61**
53 X 77	116.33	131.05	123.69	244.48	97.66**	86.55**
62 X 77	81.63	131.05	106.34	183.8	72.84**	40.25**
67 X 77	80.33	131.05	105.69	245.54	132.32**	87.36**
79 X 77	216.92	131.05	173.99	286.24	64.52**	31.96**
80 X 77	135.42	131.05	133.24	210.07	57.66**	55.12**
81 X 77	117.9	131.05	124.48	239.57	92.46**	82.81**

** Significant at $P \leq 0.01$

Table 3 Heterosis and heterobeltiosis percentage for fruit weight per plant of 11 tested-hybrids and fruit weight per plant means of their counterpart parents.

Hybrid	Fruit weight per plant				Heterosis (%)	Heterobeltiosis (%)
	P_1	P_2	MP	F_1		
1 X 77	27.53	28.29	27.91	103.92	272.34**	267.34**
2 X 77	66.93	28.29	47.61	111.92	133.61**	66.17**
3 X 77	56.22	28.29	42.25	128.00	202.89**	127.68**
4 X 77	42.45	28.29	35.37	82.52	133.31**	94.39**
14 X 77	48.12	28.29	38.21	105.30	175.58**	118.39**
53 X 77	94.08	28.29	61.19	113.90	86.14**	21.07**
62 X 77	41.54	28.29	34.92	90.98	160.54**	119.02**
67 X 77	102.30	28.29	65.30	119.05	82.31**	16.37**
79 X 77	57.44	28.29	42.87	88.96	107.51**	54.87**
80 X 77	68.08	28.29	48.19	78.06	61.98**	14.66**
81 X 77	62.43	28.29	45.36	117.76	159.61**	88.63**

** Significant at $P \leq 0.01$

of fruits per plant and positively correlated with fruit weight per plant but negatively correlated with fruit length and fruit width. This indicated that an increase in plant height and canopy width were associated with an increase in number of fruits per plant and fruit weight per plant but reduction in fruit size.

Fruit length was positively correlated with fruit width and fruit weight per plant. Fruit width was positively correlated with fruit weight per

Table 4 Correlation coefficient among characteristics of 11 tested-hybrids and their counterpart parents.

Characteristic	Canopy height	Canopy width	Fruit length	Fruit width	No. of fruits/plant
Canopy width	-0.03				
Fruit length	0.02	-0.18			
Fruit width	0.22	-0.35	0.10		
No. of fruits/plant	0.24	0.78**	-0.15	-0.58**	
Fruit weight/plant	0.20	0.51*	0.35	0.26	0.65**

* Significant at $p \leq 0.05$

** Significant at $p \leq 0.01$

plant but highly and negatively correlated with number of fruits per plant. Number of fruits per plant was highly and positively correlated with fruit weight per plant and negatively correlated with fruit width. This indicated that an increase in number of fruits per plant was associated with reduction in fruit size. These results were similar to several previous studies (Mushi *et al*., 2000; Poca, 2002 and Adthalungrong, 1995).

CONCLUSION

The results from this experiment showed highly significant differences among 11 tested-hybrids and their counterpart parents for 6 characteristics. The tested-hybrids showed heterosis and heterobeltiosis percentage for yield per plant. The hybrids No. 1 x 77, 3 X 77, 4 x 77, 14 x 77, 53 X 77, 62 x 77 and 67 x 77 had the highest heterosis for number of fruits per plant and fruit weight per plant. Therefore, the female parental lines that had high specific combining ability (SCA) were No. 1, 3, 4, 14, 53, 62 and 67. All these parental lines should be used as the female parental lines with their counterpart male tester for commercial hybrid production.

The relationship among the characteristics of 11 tested-hybrids and their counterpart parents showed that the canopy size was positively correlated with number of fruits per plant and fruit weight per plant. The fruit size was positively correlated with fruit weight per plant but negatively correlated with number of fruits per plant.

Hybrids No. 3 X 77 and 4 X 77 had compact canopy, the fruit had similar taste and shape to chilli and high number of fruits per plant, hybrid No. 53 X 77 had compact canopy, long fruit and high number of fruits per plant. They can be used as both potted plants for decoration or consumed with food. The hybrid No. 62 X 77 had wide canopy and high number of fruits per plant, which is suitable for hanging plant.

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