J. Agric. Sci. Mansoura Univ., 34 (8): 8935 - 8947, 2009

STUDIES ON PRODUCTION OF SOME HOT PEPPER (*Capsicum annuum* L.) HYBRIDS.

El-Gazzar, T. M.; E. A. Tartoura and M. M. Nada
Vegetable and Floriculture Dept., Fac. of Agric., Mansoura University.

ABSTRACT

This experiment was carried out at the special farm in El-maia, Dikirnis District, Dakahlia Governorate, Egypt, during 2005 to 2008 seasons. The genetic materials used in the present investigation included two cultivars (F_1 hybrid). The two hybrids belonging to (*Capsicum annuum* L.) which were selfed for five generations during 2005 to 2007 in summer and winter of each season consecutive, to obtain six inbred lines, these lines were called as P1, P2, P3, P4, P5 and P6 which were used in half diallel cross mating design to obtain 15 F_1 hybrids. The original populations, inbred lines and their F_1 hybrids were evaluated for some economic traits; vegetative growth, flowering, fruit, yield and its component as well as quality traits in field trial during summer 2008 season. The obtained results showed that the highest values recoded in the F_1 hybrids compare with original populations and inbred lines were; i.e., P1xP2 and P1xP6 for earliness; P2xP5 for fruit set percent; P2xP6 and P5xP6 for early yield per plot; P3xP4 for total yield per plot; P2xP5 and P1xP2 for total fruit number per plant. As well as, quality traits; i.e., P2xP3, P1xP2 and P1xP3 for total soluble solid in green fruit, P1xP2 and P1xP4 in red fruit; P3xP4, P3xP6 and P4xP6 for ascorbic acid in green fruit, P3xP6 for ascorbic acid in red fruit; P2xP3 and P1xP3 for carotene content in green fruit. However, P1xP2 was the best in red fruit. These crosses could be used in breeding program according to their objectives. Moreover, some of these F_1 hybrids can be used as commercial cultivars which may competate with imported hybrids.

INTRODUCTION

Hot pepper (*Capsicum annuum* L.) is considered one of the most favorable and common vegetable crops grown in Egypt, as well as, in other countries. It's cultivated under open field and in greenhouses conditions. Therefore, it's available in the market all the year around, Ibrahim (2007). Hot pepper (*Capsicum annuum* L.) are valuable on account of their richness in ascorbic acid, which is an important vitamin. The fruit color is due to the presence of total carotenoids pigments. The extent of coloring matter is used to impart colour to the other food products, kumar (2003). Hot pepper shows a wide range of variation for growth characteristics Villalon, (1983); Crossman *et al.* (2000), Kumar and Lal (2001), Elizabeth *et al.* (2003), Sreelathakumary and Rajamony (2003), Qaryouti *et al.* (2003), Manju and sreelathakumary (2004), Geleta *et al.* (2004), Khalaf-Allah *et al.* (2004), Nwachukwu *et al.* (2007), Mahajan *et al.* (2007), Rodriguez *et al.* (2008), for flowering traits, Mohamed (2004), Legesse (2001), Elizabeth *et al.* (2003), Sreelathakumary and Rajamony (2003), Cho *et al.* (2003), Geleta *et al.* (2004), Khalaf-Allah *et al.* (2004), El-Gazzar *et al.* (2007) and Rodriguez *et al.* (2008), for fruit characteristics, Elizabith *et al.* (2003), El-Gazzar *et al.* (2007), Rodriguez *et al.* (2008), for yield and its components traits, Olufolaji and Makinde (1994), Mohamed *et al.* (1995), Sabrina *et al.* (2003), Valsikova and Belko (2004), El-

Gazzar *et al.* (2007), Rodriguez *et al.* (2008), As well as quality traits, Khalil *et al.* (1988), Kumar *et al.* (2003), Hornero *et al.* (2004), Perucka and Materska (2007). The objectives of this study was to characterize the efficiency of the selection of hot pepper lines from two populations; Autlan and HP192. Also, the objective of this study was to produce hot pepper inbred lines and crossing them to obtained F_1 hybrid which evaluated for some economic traits to determine the best genotypes for commercial production. Also, to show the best genotypes could be used in the program of hot pepper breeding to improve hot pepper hybrids.

MATERIALS AND METHODS

In this investigation six lines which were desired from two different populations and their 15 F_1 hybrids were used as genetic materials. The experiment were designed in a randomized complete block design (R.C.B.D) with three replicates. Each replicate consisted of 23 plots which included: two original populations (Autlan, HP192), 6 inbred lines and their 15 F_1 hybrids. Every plot consists of one ridge 10 m. long and 1 m. wide. In each replicate, 20 plants for each genotype were planted in a single row at spacing of 1 m. between rows and 50 cm. between plants within the row. Seeds were sown in mid February and forty five day old seedling was transplanted in the first week of April with one seedling per hill. Data were recorded on five plants within plot on the following traits: Vegetative traits; Plant height cm. (from the crown to the top of the plant in the end of the season), Number of branches, Internodes length (cm) and Leaf area (cm^2) (Koller, 1972). Flowering traits; Flowering date (number of days to flowering 50% of plants) and Fruit set percent. Fruit characteristics were determined by measuring the following traits on 5 randomly fruits per plot. Fruit length (cm). Fruit diameter (cm), Fruit shape index, Fruit flesh thickness (mm) and average fruit weight (g), Yield and its component traits were measured on five plants per plot and the following traits were evaluated: fruits number per plant and fruits weight per plot (Kg.). Also, Quality analysis were measured as; Dry weight of fruits (%) at two stage – green (GF) and red fruit (RF)- Samples (100g) from fresh fruits were oven dried at 70C° for 72 hours till a constant dry weight. Ascorbic acid content (mg./ 100g. fresh weight) at two stages – green and red mature fruits.(Rangana, 1979). Total soluble solid content (%) determine in green and red fruit by Abbe hand refractometer (Rick, 1974). Photosynthetic pigments (Chlorophyll and carotene) for fruits and leaves, were calorimetrically determined as described by (Mckinney, 1941). The means of these observation were used to conduct the analysis of variance among genotypes using LSD at 0.05 (SAS program, V 9.1, 2005).

RESULTS AND DISCUSSION

Vegetative traits:

Data for vegetative growth traits represented in Table (1) show significant differences among hot pepper genotypes for plant height, number of branches, internode length, leaf area and chlorophyll leaves.

Concerning plant height, data of plant height showed that the values were ranged from 56.10 to 100.53 cm. for P1 and cross P3xP5, respectively. On the other hand, the crosses P2xP3, P2xP5, P3xP5 significantly exceeded than all original populations. While, the crosses P2xP5, P3xP5 were significantly exceeded than all the studied inbred lines. These results in agreement with, Crossman *et al.* (2000), Kumar and Lal (2001), Elizabeth *et al.* (2003), Sreelathakumary and Rajamony (2003), Qaryouti *et al.* (2003), Geleta *et al.* (2004), Khalaf-Allah *et al.* (2004), Nwachukwu *et al.* (2007), Mahajan *et al.* (2007) and El-Gazzar *et al.* (2007).

Table (1): Means performance of hot pepper genotypes for vegetative traits

Characters / Genotypes	Plant height (cm)	Number of branches	Internode length (cm)	Leaf area/ plant (cm^2)	Chlorophyll leaves (mg/g.)
Original populations					
Autlan	82.70ghij	9.87ij	3.30j	498.4efg	0.408m
HP192	89.70cdef	8.47bcdef	7.00bc	535.2cde	0.928a
Inbred lines					
P1	56.10m	9.00ghij	3.07j	260.6k	0.655l
P2	84.50fghi	12.33a	4.63hi	473.7g	0.686jkl
P3	91.70bc	8.87hij	5.73ef	581.3c	0.812cde
P4	74.66kl	7.27k	5.07gh	271.7k	0.779efg
P5	89.76cdef	9.73cdefg	7.93a	685.6b	0.839bcd
P6	69.76l	6.07l	5.60efg	303.0jk	0.747fghi
F_1 hybrids					
P1 x P2	73.70kl	9.90bcde	4.10i	375.9h	0.713hijk
P1 x P3	85.53efghi	9.97bcde	4.60hi	492.9efg	0.738ghij
P1 x P4	78.76jk	9.70cdefg	4.23i	287.5jk	0.763efgh
P1 x P5	86.06defgh	9.30efgh	5.00gh	482.5fg	0.845bc
P1 x P6	77.43jk	9.23efghi	4.60hi	298.4jk	0.716hijk
P2 x P3	95.90ab	10.63b	5.50efg	668.3b	0.748fghi
P2 x P4	90.73bcd	10.33bc	5.20fgh	310.5jk	0.699ijkl
P2 x P5	100.53a	10.17bcd	6.63bcd	409.2h	0.784defg
P2 x P6	86.53cdefgh	9.50defgh	5.23fgh	374.5hi	0.780efg
P3 x P4	87.00cdefg	9.43defgh	5.60efg	466.7g	0.894ab
P3 x P5	98.60a	9.10fghij	7.03bc	784.3a	0.879ab
P3 x P6	85.06efghi	8.33j	6.00de	572.2cd	0.799cdef
P4 x P5	90.26cde	9.27efgh	6.40cd	510.2efg	0.788defg
P4 x P6	80.16ij	8.87hij	5.73ef	323.6ij	0.767efgh
P5 x P6	81.43hij	9.07ghij	7.07b	527.6def	0.673kl
LSD 0.05	5.4171	0.7748	0.6458	50.939	0.0555

Means with the same letter in the same column are not significantly different (L.S.D at 0.05 level of probability)

Concerning number of branches per plant, data for these trait showed that there were significant differences among genotypes for number of branches per plant. The greatest value (12.33) was obtained by P2. While, the lowest value (6.07) was gained by the inbred line P6. As for F_1 hybrids, the crosses P2xP3, P2xP4 and P2xP5 were gave higher values compared with all original populations and their inbred lines except P2. These results in agreement with, Crossman *et al.* (2000), Kumar and Lal (2001) Elizabeth *et al.* (2003), Kumar *et al.* (2003), Sidky (2003) and Mahajan *et al.* (2007).

Regarding internode length, data listed in Table (1) indicated that there were significant differences among hot pepper genotypes, while the values ranged from 3.07 cm. to 7.93 cm. for P1 and P5, respectively. Concerning F_1 hybrids, the P3xP5 and P5xP6 were significant exceeded the original populations and inbred lines except HP192 and P5 which recorded 7.00 and 7.93 cm, respectively. The similar results are reported by Sreelathakumary and Rajamony (2003) and Rodriguez *et al.* (2008).

Also, the results of leaf area listed in Table (1) mentioned that there were significant differences among genotypes, the highest value was obtained by the cross P3xP5 (784.3 cm^2), On the contrast, the lowest leaf area was gained by P1 (260.6 cm^2), While, the crosses P3xP5 and P2xP3 were significant more than original populations. Although, the cross P3xP5 was greatest significant than all inbred lines. These observation were recorded earlier by Uddin *et al.* (2003), Sreelathakumary and Rajamony (2003), Khan *et al.* (2005).

Concerning chlorophyll leaves content, comparison among means of various genotypes were arranged in Table (1). The results clearly show that Autlan cultivar (0.408) had the least value. In contrast, the greatest value obtained by the cultivar HP192 (0.928). However, some crosses were intermediate, while others were significant exceeded than their some inbred lines. As well as, the crosses P3xP4 and P3xP5 significantly exceeded than all inbred lines except P5.

Flowering traits:

Data presented in Table (2) indicated that there were significant differences among all studied genotypes for flowering traits.

Concerning flowering date, comparison among means of various genotypes were arranged in Table (2) Data clearly show that P1xP2 (45.13 days) had the lowest number of days from transplanting to flowering 50% of plants and as a result it's the earliest cross. On the other hand, the longest period were obtained by P3 (61.17 days) and P4 (60.40 days) inbred lines. However, some crosses were intermediate, while others were earlier in flowering date than inbred lines such as P1xP2 (45.13 days) and P1xP6 (45.67 days). These results are in the same trend reported by Geleta (2001), Elizabeth *et al.* 2003, Sreelathakumary and Rajamony (2003), Cho *et al.* (2003), Geleta *et al.* (2004), Khalaf-Allah *et al.* (2004), El-Gazzar *et al.* (2007) and Rodriguez *et al.* (2008).

Regarding fruit set percent, data listed in Table (2) indicated that there were significant differences among genotypes for fruit set percent. The values ranged from 62.83% to 81.73% in P6 and P2xP5, respectively. While, the cross P2xP5 was significant exceeded than the original populations and inbred lines except P2 and P5. The similar results are reported by Mohamed (2004).

Fruit characteristics:

Significant variation was detected among genotypes for fruit length, fruit diameter, fruit shape index, fruit flesh thickness and average fruit weight.

Table (2): Means performance of hot pepper genotypes for flowering traits

Traits / genotypes	Flowering date	Fruit set %
Original populations		
Autlan	51.40gh	65.47fgh
HP192	58.60bc	71.70cd
Inbred lines		
P1	47.20klm	70.57cde
P2	54.33def	79.33ab
P3	61.17a	66.20efgh
P4	60.40ab	71.87cd
P5	54.93de	78.43ab
P6	50.80hi	62.83h
F_1 hybrids		
P1 x P2	45.13m	73.10cd
P1 x P3	49.07ijk	65.73fgh
P1 x P4	47.30klm	72.73cd
P1 x P5	47.63kl	73.60cd
P1 x P6	45.67lm	64.70gh
P2 x P3	54.30def	69.50def
P2 x P4	53.20efg	75.20bc
P2 x P5	50.33hij	81.73a
P2 x P6	48.60ijk	66.40efgh
P3 x P4	58.50bc	66.37efgh
P3 x P5	56.37cd	69.00defg
P3 x P6	52.33fgh	63.37h
P4 x P5	53.40def	70.93cde
P4 x P6	50.20hij	66.47efgh
P5 x P6	48.37jk	69.20defg
LSD 0.05	2.3055	4.7428

Means with the same letter in the same column are not significantly different (L.S.D, 0.05 level of probability)

Concerning fruit length, data presented in Table (3) show that the mean values for fruit length. The P6 (14.26 cm) exhibited the highest mean, while the P1 (3.84 cm) had the lowest ones. For the crosses P1xP6, P2xP5, P2xP6, P3xP6, P4xP6 and P5xP6 were significant exceeded than original populations and their inbred lines except P6. The similar results were observed on pepper by Geleta (2000), Kumar and Lal (2001), Cho *et al.* (2003), Kumar *et al.* (2003), Qaryouti *et al.* (2003), Sreelathakumary and Rajamony (2003), Khalaf-Allah *et al.* (2004), Geleta *et al.* (2004), Nwachukwu *et al.* (2007), El-Gazzar *et al.* (2007), Mahajan *et al.* (2007) and Rodriguez *et al.* (2008).

Regarding fruit diameter, the results indicate that the cultivar HP192 recorded the widest fruit, On contrast, the thinnest fruit observed by the P6 inbred line. Although, the crosses P1xP3, P1xP4 and P3xP4 were significant greater than all inbred lines except P1, P3 and P4. On the other hand, the same crosses were significantly exceeded the original populations except HP192 (2.61 cm). These findings were recorded on pepper by Geleta (2001), Cho *et al.* (2003), Qaryouti *et al.* (2003), Kumar *et al.* (2003), Sreelathakumary and Rajamony (2003), Geleta *et al.* (2004), Khalaf-Allah *et*

al. (2004), El-Gazzar *et al.* (2007), Nwachukwu *et al.* (2007) and Rodriguez *et al.* (2008).

The means of genotypes for fruit shape index are illustrated in Table (3). Obiviously, data show that the P6 (9.47) and P2xP6 (9.22) exhibited the bigest fruit shape index. While, the least value was obtained by P1 (1.77). Since, the crosses P2xP6 and P5xP6 were greatest values more than original populations and inbred lines except P6. These results are in agreement with those reported by Qaryouti *et al.* (2003), Khalaf-Allah *et al.* (2004), Nwachukwu *et al.* (2007) and El-Gazzar *et al.* (2007).

The data of fruit flesh thickness indicate that there were significant differences among hot pepper genotypes, results in Table (3) showed that the highest value were recorded by the cultivar HP192 (2.85 mm) while, the lower value obtained by P2 (1.71 mm.). For F_1 hybrid, the crosses P1xP3 and P1xP4 were significant exceeded for all inbred lines except P1. Similar results were observed on pepper by Kumar and Lal (2001), Geleta *et al.* (2004), Khalaf-Allah *et al.* (2004) and El-Gazzar *et al.* (2007).

Table (3): Means performance of hot pepper genotypes for fruit characteristics

Characters / Genotypes	Fruit length (cm)	Fruit diameter (cm)	Fruit shape index	Fruit flesh thickness (mm)	Average fruit weight (g.)
Original populations					
Autlan	6.65lm	1.79fe	3.72hi	1.84mn	8.10ij
HP192	9.00ef	2.61a	3.45ij	2.85a	20.87a
Inbred lines					
P1	3.84n	2.16b	1.77l	2.56cde	5.61m
P2	9.23e	1.39i	6.66cd	1.71n	7.10kl
P3	7.81hij	2.06bcd	3.80hi	2.32fgh	10.53fg
P4	7.18jkl	2.26b	3.19jk	2.54ed	12.81d
P5	9.18e	1.66fg	5.53f	1.99jklm	9.24h
P6	14.26a	1.51ghi	9.47a	1.81mn	14.60b
F_1 hybrids					
P1 x P2	6.92kl	1.88de	3.72hi	2.15ghij	6.53l
P1 x P3	6.04m	2.19b	2.75k	2.73abc	8.29ij
P1 x P4	7.14jkl	2.24b	3.20jk	2.80ab	9.52h
P1 x P5	7.26jkl	1.92de	3.79hi	2.13hijk	7.65jk
P1 x P6	10.17d	1.73ef	5.87ef	1.92lm	9.85gh
P2 x P3	8.22fghi	1.83ef	4.50g	1.92lm	8.50i
P2 x P4	8.12ghi	1.92de	4.24gh	2.33fg	10.58f
P2 x P5	10.13d	1.62fgh	6.25de	1.94klm	8.40i
P2 x P6	13.21b	1.43hi	9.22a	1.83mn	10.27fg
P3 x P4	7.63ijk	2.14bc	3.58ij	2.63bcd	11.34e
P3 x P5	8.91efg	1.92de	4.66g	2.06ijkl	10.34fg
P3 x P6	11.33c	1.84ef	6.18de	2.20fghi	13.00cd
P4 x P5	8.62efgh	1.93cde	4.47g	2.39ef	11.86e
P4 x P6	13.58ab	1.91de	7.13c	2.18ghij	13.55c
P5 x P6	13.12b	1.63fgh	8.04b	1.92lm	11.58e
LSD 0.05	0.811	0.2171	0.5165	0.1913	0.7328

Means with the same letter in the same column are not significantly different (L.S.D, 0.05 level of probability).

Regarding the average fruit weight, data listed in Table (3) illustrate that there were significant differences among genotypes. The highest value was obtained by HP192 (20.87 g.) while, the lowest value recorded by the P1

inbred line (5.61 g.). In the other word, the cross P4xP6 (13.55 g.) were significant exceeded than all inbred lines except P6. This observations agree with the result obtained by Geleta (2001), Sreelathakumary and Rajamony (2003), Qaryouti *et al.* (2003), Sidky (2003), Geleta *et al.* (2004), Khalaf-Allah *et al.* (2004), El-Gazzar *et al.* (2007), Mahajan *et al.* (2007) and Rodriguez *et al.* (2008).

Yield and its component:

Early season crop:

The means of original populations, inbred lines and their F_1 hybrids for fruit number per plant and fruits weight per plot are presented in Table (4). For the number of fruits per plant, data show that there were significant differences among genotypes. The values ranged from 20.67 to 64.00 in P4 and P2xP5, respectively. As for F_1 hybrids, the crosses P2xP5, P2xP6, P2xP4 and P1xP5 were significant exceeded than all original populations and inbred lines. These results agree with Ibrahim (2007). Concerning fruits weight per plot, the crosses P2xP6 and P5xP6 obtained the highest values, which significant exceeded than the original populations and inbred lines. This observations in agreement with, Khalaf-Allah *et al.* (2004) and El-Gazzar *et al.* (2007).

Mid season crop:

Data presented in Table (4) revealed that there were significant differences among hot pepper genotypes for fruits number per plant and fruits weight per plot. For number of fruits per plant, data show that there were significant differences among genotypes. The values ranged from 55.67 to 128.33 in HP192 and Autlan, respectively. The crosses P1xP2, P2xP5 and P1xP5 were significant exceeded than all inbred lines except P2. Concerning fruits weight per plot, the crosses P4xP5 and P3xP4 obtained the highest values, which significant exceeded for all inbred lines. While, the data show that highest values obtained by the cultivar HP192 (23.431 kg).

Late season crop:

The means of genotypes for late fruits number per plant and fruits weight per plot are presented in Table (4). Regarding number of fruits per plant, data show that there were significant differences among genotypes. the values ranged from 33.67 to 84.33 in P1xP6 and Autlan, respectively. In the case of F_1 hybrids, the crosses P1xP2, P2xP3 and P2xP5 were significant more than inbred lines except P2. Means of fruits weight per plot were represented in Table (4) clear that there were significant differences among genotypes, which cleared that the cross P3xP6 were exceeded than the inbred lines except P4 and P6.

Total yield:

The means of original populations, inbred lines and their F_1 hybrids for fruits number per plant and fruits weight per plot are presented in Table (4). For number of fruits per plant, data show that there were significant differences among genotypes. The values ranged from 117.33 to 265.33 in HP192 and Autlan, respectively. As for F_1 hybrids, the crosses P2xP5, P1xP2, P1xP5 and P2xP3 were significant greatest than all inbred lines except P2 (261.00), On the other hand, all F_1 hybrids significant exceed than

the HP192 cultivar. Concerning fruits weight per plot, the highest value obtained by the cultivar HP192. On the other hand, the least value recorded by the P1 inbred line. The cross P3xP4 were significant exceeded than all inbred lines. Meanwhile, the crosses P2xP4, P2xP5, P2xP6, P3xP6, P4xP5 and P4xP6 were significant highest than inbred lines except P6. This observations in agreement with, Crossman *et al.* (2000), Doshi *et al.* (2001), Geleta (2001), Kumar and Lal (2001), Cho *et al.* (2003), Qaryouti *et al.* (2003), Sreelathakumary and Rajamony (2003), Sidky (2003), Geleta *et al.* (2004), Khalaf-Allah *et al.* (2004), El-Gazzar *et al.* (2007), Mahajan *et al.* (2007) and Rodriguez *et al* (2008).

Table (4): Means performance of hot pepper genotypes for yield and its component

Characters / Genotypes	Early season crop		Mid season crop		Late season crop		Total yield	
	F.N/P	F.W/P	F.N/P	F.W/P	F.N/P	F.W/P	F.N/P	F.W/P
Original populations								
Autlan	52.67defg	9.342ef	128.33a	20.743bc	84.33a	12.429de	265.33a	43.014bc
HP192	23.33mn	10.354cde	55.67j	23.431a	38.67ki	14.901a	117.33k	48.903a
Inbred lines								
P1	30.00lm	3.656l	87.67cdef	9.839i	56.00efg	5.735j	173.67h	19.481j
P2	53.67bcdef	8.328fgh	127.00a	17.996defg	80.33ab	10.353fg	261.00a	37.040fg
P3	30.67kl	6.991hij	81.33fg	17.047fgh	61.67cde	11.924de	175.33gh	36.895fg
P4	20.67n	5.686jk	66.67hi	17.004fgh	59.33ef	14.144abc	146.67j	37.579efg
P5	37.33ijk	7.523ghi	94.33cd	17.376fgh	66.00cd	11.118ef	197.67def	36.516fg
P6	21.33n	6.683ij	62.00ij	18.038defg	55.33fgh	14.982a	136.67j	39.887cdef
F_1 hybrids								
P1 x P2	33.33jkl	4.505kl	124.67a	16.915fgh	75.67b	8.965gh	234.67b	30.664i
P1 x P3	43.33hi	7.909fghi	96.67c	15.790gh	56.00efg	8.547hi	196.00def	32 541hi
P1 x P4	38.00ij	7.912fghi	93.67cd	17.946defg	49.00ij	8.272hi	180.67fgh	34.366ghi
P1 x P5	59.67abcd	9.920de	111.00b	17.407fgh	52.00ghi	7.114ij	222.67bc	34.145ghi
P1 x P6	49.67efgh	9.062efg	94.00cd	20.280bcd	33.67l	6.478j	177.33gh	34.935gh
P2 x P3	55.33bcde	9.299ef	95.67c	16.703gh	74.33b	12.460de	222.00bc	37.693defg
P2 x P4	60.33abc	12.092b	84.00ef	17.547efgh	59.00ef	13.178bcd	203.33de	42.892bc
P2 x P5	64.00a	12.271b	113.00b	20.039bcde	75.00b	10.120fg	252.00a	42.318bc
P2 x P6	60.67ab	13.979a	83.33f	17.375fgh	67.67c	11.892de	211.67cd	43.448bc
P3 x P4	46.00gh	11.080bcd	93.00cde	21.482abc	56.33efg	11.845de	195.33def	44.369b
P3 x P5	53.33cdef	11.617bc	96.00c	20.076bcde	43.00jk	8.308hi	192.33efg	39.760cdef
P3 x P6	33.67jkl	9.336ef	72.33gh	19.436cdef	61.00def	14.348ab	167.00hi	43.476bc
P4 x P5	33.67jkl	7.705ghi	85.33def	22.371ab	58.33ef	12.837cd	177.33gh	42.051bc
P4 x P6	32.00jkl	9.070efg	71.00hi	19.417cdef	49.67hi	12.726cd	152.67ij	41.384bcd
P5 x P6	48.00fgh	12.465ab	71.00hi	15.058h	58.00efg	12.946bcd	177.33gh	41.072bcde
LSD 0.05	7.0599	1.5546	9.0478	2.5841	6.0965	1.4736	17.036	3.7904

Means with the same letter in the same column are not significantly different (L.S.D, 0.05 level of probability). F.N/P: fruits number per plant. **F.W/P:** fruits weight per plot.

Quality characteristics:

Significant variation was detected among genotypes for fruit dry weight, total soluble solid , ascorbic acid content, chlorophyll content in green fruit and caroten content in green and red fruit.

As for dry weight of fruits, data in Table (5) demonstrate the presence of significant variation among genotypes for dry weight of green and red fruits. concerning dry weight of green fruits, data show that the values ranged from 7.67 to 13.40 in the P6 and P2 respectively. In the same time, the

crosses P3xP5 and P2xP3 significantly exceeded than the original popultions and inbred lines except the P2 inbred line. These results are in the same trend reported by Uddin *et al.*, (2003).

Regarding dry weight of red fruits, the results showed that the values ranged from 8.91 to 18.92 in the inbred lines P6 and P2, respectively. As for F_1 hybrids, the cross P2xP3 exhibited highest value compared with original populations and all inbred lines except P2. This findings were recorded by Uddin *et al.* (2003) and Perucka and Materska (2007).

Concerning total soluble solid, data presented in Table (5) show the mean values for TSS in green fruit. The inbred line P2 and the cross P2xP3 (7.73) exhibited the highest mean value, while the P6 (5.20) had the lowest ones. As for the crosses P2xP3, P1xP2 and P1xP3 were significant exceeded than all original populations and inbred lines except P2 and P3. These results in agreement with Geleta *et al.* (2004) and El-Gazzar *et al.* (2007).

In respect with total soluble solid in red fruit, data presented show that values ranged from 6.87 to 9.97 in P2 and P1xP2, respectively. As for the crosses P1xP2 and P1xP4 were significant exceeded than all original populations and inbred lines except P2 and P4. These results were similar according to Khalil and Omran (1982) and Geleta *et al.* (2004).

Regarding ascorbic acid content in green fruit, the results arranged in Table (5) indicate that there were significant differences among hot pepper genotypes. Data clear that, the crosses P3xP4, P3xP6, P4xP6 and P2xP6 recorded the highest values which significant exceeded the original populations and inbred lines except HP192, P4 and P6 genotypes. while, the values ranged from 90.0 in P1 inbred line to 114.0 in P3xP4, P3xP6, P4xP6 crosses. These results in agreement with Panchal *et al.* (2001), Geleta *et al.* (2004), El-Gazzar *et al.* (2007) and Kumar *et al.* (2003).

With respect to ascorbic acid content in red fruit, the results indicate that the genotypes P3xP6 and P6 recorded the highest value (157.5). On contrast, the lowest value (114.0) observed by the P1 inbred lines. Although, the cross P3xP6 were significant greater than all inbred lines and original populations except P6. These results in agreement with Perucka and Materska (2007), Geleta *et al.* (2004), Kumar and Lal (2001), Kumar *et al.* (2003) and Valsikova (1986), Kouser *et al.*, (2003).

The data of carotene content indicate that there were significant differences among hot pepper genotypes for carotene of green and red fruits. Concerning of green fruits, results listed in Table (5) demonstrate the presence of significant variation among genotypes. Data show that the values ranged from 0.007 to 0.134 mg/g. in the P6 and P2xP3, respectively. For F_1 hybrids, the crosses P2xP3, P1xP3 and P1xP2 significantly exceeded than the original populations and inbred lines except the P3 and P2 inbred lines. Other investigators reported the similar results as Kumar *et al.* (2003), Perucka and Materska (2007).

Regarding carotene content in red fruit, the means of genotypes for carotene in red fruit are illustrated in Table (5). Obviously, data show that the P2 (1.339) exhibited the highest value. While, the least value was obtained by HP192 (0.445). Since, the crosses P1xP2. P1xP3, P2xP3, P2xP5 and P2xP6

were greatest values more than original populations and inbred lines except P2 and P1. These findings are agreement with those reported by Zaky *et al.* (2001), Kumar *et al.* (2003), Perucka and Materska (2007) and Hornero *et al.* (2004).

Dealing with chlorophyll green fruit content, data listed in Table (5) indicated that there were significant differences among genotypes for chlorophyll content. The values ranged from 0.054 to 0.318 in P4 and P2xP3, respectively. While, the crosses P2xP3 and P1xP3 was significant exceeded the original populations and inbred lines except P4.

Table (5): Means performance of hot pepper genotypes for qauality characteristics

Characters / Genotypes	Dry weight of fruit (%)		Total soluble solid (%)		Ascorbic acid content (mg/100g)		Carotene content (mg/g)		Total Chlorophyll (mg/g.)
	green fruit	red fruit	green fruit	red fruit	green fruit	red fruit	green fruit	red fruit	green fruit
Original populations									
Autlan	11.58cde	16.44b	6.93def	8.80d	105.0cdef	126.0ijk	0.079e	0.940de	0.192c
HP192	9.10jk	10.27i	5.27j	8.33e	111.0ab	150.0b	0.010lm	0.445i	0.112efg
Inbred lines									
P1	9.87i	14.42de	7.20c	9.13cd	90.0k	114.0m	0.088d	1.278a	0.250b
P2	13.40a	18.92a	7.73a	9.80ab	94.5ijk	121.5kl	0.107bc	1.339a	0.264b
P3	11.36cdef	17.33b	7.60ab	8.20ef	108.0bcd	144.0bcd	0.132a	0.877e	0.317a
P4	9.65ij	13.45f	6.47gh	9.53bc	111.0ab	135.0fgh	0.015l	0.532h	0.054h
P5	10.75fgh	12.32g	6.27h	7.40hi	93.0jk	126.0ijk	0.031j	0.634g	0.116efg
P6	7.67l	8.91j	5.20j	6.87j	111.0ab	157.5a	0.007m	0.582gh	0.060h
F_1 hybrids									
P1 x P2	11.55cde	16.99b	7.60ab	9.97a	94.5ijk	123.0jkl	0.104c	1.333a	0.271b
P1 x P3	10.60gh	16.48b	7.60ab	9.13cd	106.5bcde	129.0hij	0.113b	1.054c	0.301a
P1 x P4	10.14hi	14.53de	7.03cde	9.63ab	108.0bcd	120.0klm	0.051h	0.911e	0.133de
P1 x P5	10.78fgh	12.93fg	6.70fg	7.50ghi	96.0hij	118.5lm	0.057h	0.998cd	0.153d
P1 x P6	8.98jk	11.09hi	6.37h	7.13ij	102.0efg	138.0def	0.042i	0.920de	0.100g
P2 x P3	12.69ab	18.61a	7.73a	9.53bc	100.5fgh	135.0fgh	0.134a	1.170b	0.318a
P2 x P4	11.83cd	14.97cd	7.30bc	9.47bc	109.5abc	130.5ghi	0.068f	0.888e	0.143d
P2 x P5	12.07bc	14.36de	7.17cd	8.93d	99.0ghi	126.0ijk	0.069f	1.171b	0.212c
P2 x P6	10.65fgh	13.76ef	5.73i	7.80fgh	111.0ab	135.0fgh	0.064fg	1.147b	0.128def
P3 x P4	11.21efg	15.52c	7.27c	8.83d	114.0a	148.5bc	0.079e	0.767f	0.194c
P3 x P5	12.76ab	14.62de	6.80ef	7.90fg	103.5defg	136.5efg	0.079e	0.780f	0.258b
P3 x P6	9.09jk	13.30f	6.27h	7.47hi	114.0a	157.5a	0.058gh	0.788f	0.262b
P4 x P5	10.93efg	13.25f	6.27h	8.33e	102.0efg	142.5cde	0.023k	0.580gh	0.097g
P4 x P6	8.47k	11.18h	6.20h	7.77gh	114.0a	147.0bc	0.011lm	0.618gh	0.096g
P5 x P6	9.15jk	10.65hi	5.80i	7.30i	99.0ghi	144.0bcd	0.024jk	0.636g	0.105fg
LSD 0.05	0.7179	0.898	0.3324	0.4071	5.6604	6.243	0.0073	0.0869	0.0265

Means with the same letter in the same column are not significantly different (L.S.D, 0.05 level of probability).

From the previous results its concluded that, the obtained results showed that the highest values recoded in the F_1 hybrids compare with original populations and inbred lines were; i.e., P1xP2 and P1xP6 for earliness; P2xP5 for fruit set percent; P2xP6 and P5xP6 for early yield per plot; P3xP4 for total yield per plot. As well as, red fruit was greatest values than green fruit for quality traits except chlorophyll content; i.e., P2xP3, P1xP2 and P1xP3 for total soluble solid in green fruit, P1xP2 and P1xP4 in red fruit; P3xP4, P3xP6 and P4xP6 for ascorbic acid in green fruit, P3xP6 for ascorbic acid in red fruit; P2xP3 and P1xP3 for carotene content in green fruit. However, P1xP2 was the best in red fruit. These crosses could be used

in breeding program according to their objectives. Moreover, some of these F_1 hybrids could be used as commercial cultivars which may competate with imported hybrids.

REFERENCES

Cho, M.C.; D. H. Pae; Y.S. Cho; Y. Chae; W.M. Lee; D.H. Kim; Y. H. Om; D. S. Kim; S. R. Cheong; L. G. Mok; J. Y. Yoon (2003). A new once-over harvest-type variety "saeng- ryeog No. 216" in red pepper (*Capsicum annuum* L.). Capsicum and Eggplant Newsletter. No. 22: 27-28.

Crossman, S. M. A.; M. C. Palada and A. M. Davis (2000). Performance of west Indian hot pepper cultivars in the Virgin Islands. Proceeding of the 35th Annual Meeting, Caribbean Food Crops Society, Castries, St. Lucia, 25-31 July 1999.

El-Gazzar, T. M.; S. M. Farid and K. Y. Ibrahim (2007). Studies on production of hybrids pepper (*Capsicum annuum* L.): 1- Evaluation and characterization of some sweet pepper (*Capsicum annuum* L.) Genotypes for some economic traits. J. Agric. Sci. Mansoura Univ., 32(6): 4963-4701.

Elizabeth, V. Cherian and P. Indira (2003). Variability in Capsicum chinense Jacq. germplasm. Capsicum and Eggplant Newsletter 22: 47-50.

Geleta, L. F. and M. T. Labuschagne (2004). Hybrid performance for yield and other characteristics in peppers (*Capsicum annuum* L.). Journal of Agricultural Science. 142(4): 411-419.

Hornero Mendez, D.; RGL de Guevara; M.I. Minguez Mosquera and R.G.L De Guevara (2000). Carotenoid biosynthesis changes in five red pepper (*Capsicum annuum* L.) cultivars during ripening. Cultivar selection for breeding. Journal of agriculture and food chemistry. 48:9, 3875-3864.

Ibrahim, K. Y. (2007). Studies on production of hybrids pepper (*Capsicum annuum* L.). Ph. D. Thesis, Fac. Of Agric. Mansoura Univ. Egypt.

Khalf-Allah, A. M., E.M.S. Helmy, H.M. Bdre, and E.I.M. Ragheb (2004). Combining ability and heterosis in sweet pepper (*Capsicum annuum* L.). J. Agric. Sci. Mansoura Univ., 29(3): 1367 – 1380.

Khalil, R. M. and A. F. Omran (1982). Total soluble solids and ascorbic acid inheritance in pepper fruits (*Capsicum annuum* L.) Minufiya J. Agric., Res., 5: 363-379.

Khalil, R. M., N. M. Malash and E. Metwally (1988). Phenotypic behavior of some introduced pepper cultivars under plastic houses in winter season . Minufiya Jour. Agric. Res. 13(1): 227-245.

Khan M.; T. H.; T. H. Chattha and N. Saleem (2005). Influence of different irrigation intervals on growth and yield of bell pepper (*Capsicum annuum* Grossum Group). Research Journal of Agriculture and biological Sciences 1(2): 125-128.

Koller, H.R.C. (1972). Leaf area – leaf weight relationship in the soybean canopy. Crop Sci., 12: 180 – 183.

Kouser, P. Wani; N. Ahmed; M. I. Tanki and Raj Narayan (2003). Stability analysis for yield and quality characters in hot pepper (*Capsicum annuum* L.). Capsicum and Eggplant Newsletter 22: 75-78.

Kumar, B. K.; A. D. Munshi; Subodh Joshi and Charanjit Kaur (2003). Note on evaluation of chilli (*Capsicum annuum* L.) genotypes for biochemical constituents. Capsicum and Eggplant Newsletter 22 : 41-42.

Kumar, R. and G. Lal (2001). Expression of heterosis in hot pepper (*Capsicum annuum* L.). Capsicum and Eggplant Newsletter No. 20: 38 – 41.

Legesse, G. (2001). Performance of the 9th international chilli pepper nursery at Melkasa, Ethiopia. Capsicum and Eggplant Newsletter No. 20: 53-54.

Mackinny, G. (1941). Absorption of light by chlorophyll solution. J. Biol. Chem., 140: 315 -322.

Mahajan, G.; K.G. Singh, R. Sharda and M. Siag (2007). Response of red hot pepper (*Capsicum annuum* L.) to water and nitrogen under drip and check basin method of irrigation. Asian Journal of Plant sciences 6 (5): 815 – 820.

Manju, P. R. and I. Sreelathakumary (2004). Genetic divergence in hot chilli (*Capsicum chinense* Jacq.). Capsicum and Eggplant Newsletter, No. 23: 69-72.

Mohamed, M. F. (2004). Green pepper germplasm selection for improved production under heat and drought stress conditions. Capsicum and Eggplant Newsletter. No. 23: 29-32.

Mohamed, M. A.; A. H. Khereba; E. A. Abou El-Hassan and M.H. Zaky (1995). Genetical studies on sweet pepper . 1-Genetic behaviour on yield character. Egypt. J. hort. 22, No 1, pp. 49-64.

Nwachukwu C. U., F. N. Mbagwu; A. N. Onyeji (2007). Morphological And Leaf Epidermal features of Capsicum Annum and Capsicum frutescens solanaceae. Nature and Science 5(3): 54-60.

Olufolaji, A.O. and M.J. Makine (1994). Assessment of the vegetative, reproductive characters and fruit production pattern of pepper cultivars (*Capsicum* spp.). Capsicum and Eggplant Newsletter. 13: 54-57.

Panchal, S. C.; R. Bhatnagar; R. A. Momin and N. P. Chauhan (2001). Capsaicin and ascorbic acid content of chilli as influenced by cultural practices. Capsicum and Eggplant Newsletter, No. 20: 19-22.

Perucka I. and M. Materska (2007). Antioxidant vitamin contents of (*Capsicum annuum* L.) fruit extracts as affected by processing and varietal factors. Acta Sci. Pol., Technol. Aliment. 6(4): 67–74.

Qaryouti, M. M.; H. Hamdan and M. Edwan (2003). Evaluation and characterization of Jordanian pepper (*Capsicum annuum* L.) landraces. Capsicum and Eggplant Newsletter, No. 22: 21-24.

Rangana, S. (1979). Manual analysis of fruit and vegetable products. Tata Mc Grow Hill Publishing company limited, new Delhi, 634 P.

Rick, C. M. (1974). high soluble solids content in large fruited tomato lines drived from a wild green fruited species. Hilgardia, 42 (15): 493 - 510.

Rodriguez, Y.; T. Depestre and O. Gomez (2008). Efficiency of selection in pepper lines (*Capsicum annuum* L.), from four sub-populations, in characters of productive interest. Cien. Inv. Agr. 35(1): 29-40.

Sabrina, I. Ccarvnlho; B. Luciano; Bianchetti and G.P. Henz (2003). Germplasm collection of *Capsicum* spp. Maintained by embrapa hortalicas (CNPH). Capsicum and Eggplant Newsletter No. 22: 17-20.

SAS, Inistitute (2005), SAS user's Guide; Statistics, Version 9.1. SAS Inst., Cary, NC.

Sidky, Mahassen M. A. (2003). Comparative study of some new hot pepper (*Capsicum annuum* L.) cultivars in Egypt. Journal of Agricultural Sciences, 28-2, 995-1004.

Sreelathakumary, I. and L. Rajamony (2003). Variability, heritability and genetic advance in bird pepper (*Capsicum frutescence* L.). Capsicum and Eggplant Newsletter, No. 22: 51-54.

Uddin, M. K.; K.M. Khlequezzaman; Md. Matiar Rahman; Nur-e-Alam Siddquie and Md. Omar Ali (2003). Yield and yield component of winter chilli (*Capsicum annuum* L.) as affected by different levels of nitrogen and boron. Pakistan Journal of Biological Science 6 (6): 605 – 609.

Valsikova, M. (1986). Vitamin value of capsicum. Sbornik UVTIZ, Zahradnictvi 13 (3) 219-224 (C.F.Pl.Breed. Abstr.,Vol 57(8): 7494, 1987).

Valsikova, M. and I. Belko (2004). Evaluation of sweet pepper assortment (*Capsicum annuum* L.). Capsicum and Eggplant Newsletter, No. 23: 21-24.

دراسات على انتاج بعض هجن الفلفل الحريف.

طه محمد الجزار ، السيد احمد طرطورة و محمد مسعد ندا.
قسم الخضر والزينه – كلية الزراعة – جامعة المنصورة.

أجريت عدة تجارب حقليه فى مزرعة خاصة بمنطقة دكرنس، محافظة الدقهلية خلال الفترة من ٢٠٠٥ حتى ٢٠٠٨ وذلك بزراعة صنفين من الهجن التجارية من الفلفل الحريف مع التربيه الذاتيه واجراء الانتخاب فى الجيل الانعزالى الأول، ثم التربيه الذاتيه لخمسة أجيال وفى الجيل الخامس تم الانتخاب لعدد من السلالات (٦ سلالات متجانسه)، وأجرى التهجين بين السلالات باستخدام نظام التهجين النصف دائرى وذلك للحصول على ١٥ هجين. وقد أجريت تجربه حقليه لتقييم الأباء والسلالات والهجن فى موسم صيف ٢٠٠٨ لبعض صفات النمو الخضرى، الزهرى، الثمرى، المحصول ومكوناته وكذلك بعض صفات الجودة. وأظهرت النتائج وجود اختلافات معنويه لجميع الصفات المدروسه، وكانت أهم النتائج المتحصل عليها تتمثل فى التالى بالنسبه لصفات المحصول حيث سجل الهجين P3xP4 أعلى القيم للمحصول الكلى للنبات، وكانت الهجن P2xP5 و P1xP2 سجلت أعلى القيم لعدد الثمار الكلى للنبات . وبالنسبه للمحصول المبكر أظهرت الهجن P2xP6 و P5xP6 اعلى محصول مبكر. اما بالنسبه لصفات الجودة سجلت الهجن P3xP4 ، P3xP6 و P4xP6 أعلى القيم بالنسبه لمحتوى الثمار الخضراء من حمض الأسكوربيك، بينما أعطـــى الهجين P3xP6 اعلى القيم فى الثمار الحمراء. وكانت الهجن P2xP3 ، P1xP2 و P1xP3 سجلت اعلى القيم للمواد الصلبه الذائبه الكليه فى الثمار الخضراء. بينما سجلت الهجن P1xP2 و P1xP4 أعلى محتوى للثمار الحمراء من المواد الصلبه الذائبة الكلية. ومن النتائج السابقة يتضح لنا انه من الممكن عزل سلالات متجانسه يمكن استخدامها كأصناف تجارية جديدة، أو ادخالها فى برامج التربية وانتاج الهجن المتفوقة كما تم اجراءة فى هذه التجارب.