STUDY OF GROWTH, YIELD AND PHYTOSTEROL OF SQUASH (*Cucurbita pepo* L. AND MEDICAL PUMPKIN (*Cucurbita pepo*) AND THEIR HYBRID

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ABSTRACT

This study was aimed to investigate,growth,yield and phytosterol of squash (*Cucurbita pepo* L. , medical pumpkin (*Cucurbita pepo* subsp.) and thier hybrids.The study included crossing among 15 pure lines of squash and medical pumpkin . pepo var. styriaca during fall season 2013 at greenhouse during spring 2014 the genotypes of the Department of Horticulture and Landscape Gardening, College of Agriculture, University of Baghdad. The genotypes (medical pumpkin ST + 9 parents of squash, crosses with medical pumpkin + 11 specific hybrid) were planted at the open field. The layout of the experiment was completely randomized block design. The results showed significant differences among genotypes in the studied traits. The parents ST, E1, E3, E6, K3 and K7 showed superiority when compared to other parents in vegetative and flowering growth, earliness of maturity, yield and phytosterol. Hybrids ST1 × E, H × ST1, K × ST3, K7 × ST, E6 × ST and MR × ST were significantly superiored to other hybrids in the studied characters and had highest positive and significant hybrid vigor.

Keywords: genetic diversity, specific hybridization, incompatibility, hybrid vigor, vegetable oil.

دراسة النمو والحاصل والفايتوستيرول لقرع الكوسة *Cucurbita pepo* L. والقرع الطبي (*Cucurbita pepo*) وهجنهما النوعية

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المستخلص

شملت الدراسة التضريب بين 15 سلالة نقية من سلالات قرع الكوسة *Cucurbita pepo* L. ونباتات القرع الطبي *Cucurbita pepo* subsp. var. Styriaca في الموسم الخريفي 2013 في البيت البلاستيكي . في الموسم الربيعي 2014 زرعت التراكيب الوراثية في الموسم الربيعي وشملت القرع الطبي ST + 9 أباء قرع كوسة التي نجحت تضريباتها مع القرع الطبي + 11 هجين نوعي في حقل الخضر التابع لقسم البستنة وهندسة الحدائق / كلية علوم الهندسة الزراعية / جامعة بغداد ضمن تصميم القطاعات الكاملة المعشاة RCBD بهدف انتاج هجن نوعية عن طريق التوافق الطبيعي بين الاباء والى زيادة كمية الفايتوستيرول وكمية الزيت النباتي. بينت نتائج التجربة الى وجود فروقاً معنوية بين التراكيب الوراثية في الصفات المقاسة إذ اظهرت الاباء ST و E1 و E3 و E6 و K3 و K7 تفوقها على الاباء في صفات النمو الخضري والزهري والتبكير والحاصل والفايتوستيرول وتفوقت الهجن ST×E1 و ST×H1 و ST×K3 و K7×ST و E6×ST و MR×ST معنويا على الهجن الاخرى في الصفات المقاسة وتميزت بأعطائها اعلى غزارة هجينة موجبة ومعنوية.

الكلمات المفتاحية: تنوع وراثي، تهجين نوعي، عدم توافق، قوة هجين، كمية الزيت النباتي

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INTRODUCTION

The hybrids breeding is one of the most important activity of breeder in cucurbit family due to flexibility of breeding and keeping the parents properties, as well as the high productivity of the hybrids and the homogeneity of its fruit characters and the vigor of its vegetative growth (5). Specific hybridization among highest genetic diversity is an important means of increasing economical genotype traits and breeding of new varieties and hybrids (20). Plant breeders perform hybridization among different plant species (Interspecific Hybridization) when unable to find desirable characters within the same species under impovement. Such as the breeding program which used to transfer one or more of desirable genes from one species to another to develop new characters,when did not found in either species (14). Several researchers (1), (10), (17), (22) indicated that specific hybridization between *Cucurbita pepo* L. and *C. maxima Duch* produced the best total yield. Cheng *et al*. (6) was concluded that the specific hybrids developed from crossbreeding among cucurbit family species are characterized by low number of fruits plant^{-1}, but could be increased by frequent pollination or embryo transplantation as well as under controlling environmental conditions. *Cucurbita pepo* specific hybridization sometimes is a major objective for cucurbit breeders with highest opportunity to transmit genetic characters between species, as well as finding more valuable species through traditional breeding processes. It was found that the shape of the plant and fruits tended to form the plant and fruits in *C.moschata* and *C.maxima*. Davoodi *et al* (8) found that the specific hybridization between *C.moschata Duch*, produced highest content of carotene and squash plant. Marxmathi *et al* (19) obtained a highest and significant hybrid vigor in the number of days until the female flowering and the number of nodes before the first female flower and the length and diameter of the fruit with highest hybrid vigor in the number of days until the first harvest process from the hybridization among 6 varieties of pumpkin (*cucurbita moschata Duch*.ex.poir). The study aims to produce hybrids through natural compatibility between parents and to overlap some geneticaly traits in terms of the external form and increase the amount of phytosterol, because of its importance in terms of food , medical and increase the proportion of vegetable oil in the seeds hybrids.

MATERIALS AND METHODS

The medicinal pumpkin *Cucurbita pepo* subsp. *Pepo* var. Styriaca and 15 pure lines of squash *Cucurbita pepo* seeds were planted during fall season, 2013 at the greenhouse of the Department of Horticulture and Landscape Gardening, College of Agriculture, University of Baghdad. At the flowering stage, direct crossing was conducted between the pure lines of squash plants and medical pumpkin plants and reciprocal crosses hybrids. At the maturity of the fruits, the seeds were extracted from crossed genotypes. The seeds of the first generation F1 were stored in the refrigerator for use during spring season 2014. The seeds of single cross hybrids which produced from the crossing with their parents (Medical pumpkin with symbols ST + 9 pure lines of squash with symbols (E1, E2, E3, E6, K3, K4, K7, H1, MR) as well as the failure of other parents (squash) in hybridization with medical pumpkins or in obtaining reciprocal crosses in addition to 11 specific hybrids, which symbolized (E1×ST, E2 × ST, E3 × ST, E6 × ST, K3 × ST, ST × K3, K4 × ST, K7 × ST, H1 × ST, ST × H1 and ST×MR) were covered in plastic bags until the seedling stage and then seedlings were transplanted in the field in the following spring season after the implementation of all agricultural managements until the end of the season . Measurements were recorded for the within traits of vegetative, flowering, rooting, yield, yield components and phytosterol for 10 plants from each genotype and replicate. The experiment was carried out according to the randomized complete block design (RCBD) with three replicates. The results were analysed by analysis of variance and the means were compared using least significant differences test (LSD) at 0.05 level (10). The heterosis (H) according to the highest parent (HP) was calculated for some characters using the following parameter :

Heterosis (H%) =[(F1 - $\overline{HP}$) / $\overline{HP}$]×100

Heterosis of the earliness characters, number of nodes before the formation of the first

female flower , number of days until harvest and the number of days until the female flowering, relative to the earliest parents were analysed according to the lowest parents (LP) using the following parameter :

Heterosis (H%) =[(F1 - $\overline{LP}$) / $\overline{LP}$]×100

The significances of the hybrid vigor tested using standard error (S.E).

Oil extraction

The oil was extracted by taking a representative sample of the parent seeds and specific hybrids with 10 grams and then crushed and grinded by hand mill to increase the surface area and then placed on a filter paper and closed well, then placed in a Soxhlet device and add the hexane until the sample was covered completely for 24 hours to ensure oil extraction. after following days, the extraction process started by operating the device and then boiling the hexane and re-condensing with the oil for 10 cycles at least to ensure full extraction of the amount of oil contained in the sample completely, then extracted the remaining seed sample from the Soxhlet and separated hexane from the oil which is the last stage of extraction before turning off the device, the oil was then placed in a beaker to ensure the evaporation of the hexane residue (13) then weigh and fix its volume for each sample.

Determination of phytosterol

The quantity of phytosterol was estimated according to Sabir *et al* (23) method.

RESULTS AND DISCUSSION

Vegetative growth characters

The results in Table 1 shows that there were significant differences among genotypes in the characters of vegetative growth. The parent (ST) significantly exceeded all parents in the plant length and exceeded some parents in the leaf area and plant dry weight (154.5 cm and 26.744 dm^2 and 205.4 gm), respectively. The parent (K7) was significantly superiored to some parents in number of leaves (70.3), while the parent of (E6) showed significant superiority compared to some parents in the dry weight of the roots (11.6 gm), while the parents did not show any significant differences in the number of fruit branches.

Table 1. Vegetative growth characteristics of plants and their hybrids of squash (*Cucurbita pepo* L.) and medical pumpkin

treat.	Length of plant (cm)	No.of leaves-1	No.of branches 1-	leaf area (dm)-2	dry weight of vegetable (g)	Dry weight of root (g)
E1	76.2	60.3	1.13	21.64	164.8	9.5
E2	71.7	65.7	1	23.04	150.6	8.3
E3	66.3	54.4	1	17.28	155.7	9.6
E 6	65.4	53.4	1	23.22	164.7	11.6
K3	67.2	62.1	1	22.32	154.2	8.1
K4	81.5	62.3	1	19.63	152.0	6.5
K7	73.7	70.3	1	23.00	118.2	6.1
H1	72.0	61.3	1	23.50	121.2	8.6
MR	71.3	63.3	1	20.05	206.7	8.7
ST	154.5	68.0	1	26.74	205.4	8.3
ST×E1	155.7	72.2	1	30.77	261.8	10.8
ST×E2	112.7	67.3	1	28.58	225.8	12.5
E3×ST	103.2	58.2	1	25.51	207.3	11.5
E6×ST	79.4	59.3	1	27.26	201.9	16.1
K3×ST	99.6	69.0	1.13	28.64	241.1	13.4
ST×K3	131.9	71.3	1.13	27.57	220.9	11.5
K4×ST	116.0	71.7	1	26.52	248.7	10.8
K7×ST	145.3	80.2	1	29.84	278.8	12.8
H1×ST	99.9	59.2	1	25.68	111.2	11.7
ST×H1	117.3	61.8	1	26.45	204.9	13.9
MR×ST	102.2	66.7	1	26.79	228.6	12.5
L.S.D	12.8	7.58	N.S	8.10	50.16	3.51

The differences between parents led to significant differences in the vegetative growth characters of their hybrids such as superiority of hybrid (ST × E1) compared to most hybrids in plant length that produced 155.7 cm and the hybrid (ST × K7) which was significantly superior to other hybrids in number of leaves and plant dry weight (80.2 and 278.8 gm), respectively, while the hybrid (E6 × ST) was significantly superior to most hybrids in the dry weight of the roots (16.1 gm). Also the hybrids were showed no significant superiority in the number of fruit branches. The results showed that the plant length of hybrids (ST × K3) and (ST × H1) reached 131.9 cm and 117.3 cm respectively.While the length of their reciprocal cross (K3 × ST) and (H1 × ST) (99.6 cm and 99.9 cm) respectively. The significant differences, due to the influence of cytoplasmic inharitance in controlling those characters in pumpkin family plants. It is noted that the length of the female plants (K3 and H1) reached 67.2 cm and 72.0 cm respectively, while the length of the parent plants (ST) was 154.5 cm . This variation between the means of the parents and their specific hybrids led to the hybrid vigor. The results in Table 2 indicates the superiority of the hybrid (ST × E1) in the highest positive significant heterosis compared to the highest parents in the leaf area by 14.81% , also the results were showed the highest positive heterosis of the hybrid (K7 × ST) in the number of leaves plant^{-1} and plant dry weight 12.63% and 35.21% , respectively and the hybrid of (ST × H1) was significantly superiored in roots dry weight by 57.45% compared to the highest of parents while it had zero hybrid vigor in the plant dry weight, also some hybrids showed negative hybrid vigor compared to the highest parents in some characters. could be conclude that the traits with positive values of the hybrid vigor were under the influence of over dominance, while the zero value of the hybrid vigor indicates that the character was under the influence of complete dominance and the negative values of the hybrid vigor indicate that the characters were under the influence of the partial dominance genes and the additive gens effect more active. The inheritance of vegetative growth characters in the specific hybrids were showed a positive and significant heterosis under the influence of dominant gene action, While the inheritance of vegetative growth in hybrids in which the hybrid vigor was negative, it is under the influence of the negative non additive action as indicated by several researchers (4, 12, 16).

Table 2. Hybrid strength (%) of hybrid vegetative growth characteristics of hybrids of squash (*Cucurbita pepo* L.) and medical pumpkin

Treat.	Length of plant (cm)	No.of leaves1-	leaf area (dm)2-	Dry weight of vegetable (g)	Dry weight of root (g)
E6×ST	**-48.21**	**-12.68**	**3.43**	**-1.70**	**40.87**
ST×H1	**-23.83**	**-8.93**	**-1.32**	**0.00**	**57.45**
H1×ST	**-34.80**	**-12.80**	**-3.14**	**-45.63**	**38.01**
E3×ST	**-32.84**	**-14.25**	**-5.04**	**1.15**	**20.93**
ST×E2	**-26.63**	**-2.74**	**-1.10**	**7.07**	**32.95**
MR×ST	**-33.72**	**-1.73**	**1.14**	**4.87**	**39.13**
K4×ST	**-24.65**	**5.51**	**1.17**	**21.99**	**32.08**
ST×K3	**-14.30**	**4.96**	**4.88**	**8.09**	**36.88**
K3×ST	**-35.16**	**1.47**	**6.83**	**17.64**	**54.69**
ST×E1	**1.24**	**6.34**	**14.8**	**27.18**	**11.30**
K7×ST	**-5.59**	**12.69**	**12.4**	**35.21**	**49.07**
S.E	**4.33**	**2.75**	**1.88**	**6.38**	**4.10**

Flowering and growth characters

The characters of increasing the number of female flowers and increasing the fruits set gives a clear phenomens of the number of fruits in a single plant, therefore it is an important character of flowering growth, which related to plant yield. The results in Table 3 shows that the parents E1, E2, E3, E6

and H1 had the highest number of female flowers (12.3, 12.0, 12.5, 11.4 and 11.7), respectively and a high sex ratio (male / female) reached 28.6%, 24.6%, 33.7%, 30.9% and 26.2%, respectively compared to some other parents. While the parents of E1, E6, K3, K4 and MR had the highest percentage of the fruits set which reached 67.3%, 72.8%, 72.6% and 62.9% 79.4% respectively. While the parent of (ST) produced the highest number of male flowers and the lowest number of female flowers and the lowest sex ratio and fruits set (54 male flowers, 9.0 female flowers, 16.6% and 17.4%), respectively. This variation in the characters of flowering growth between parents is due to the influence of a number of hormonal, genetic and environmental factors of these parents, as the process of flowers development and determine their sex depends on and it is action gene pairs which coniral the sex ratio of plant, which is reflected on the fruits set percent in the plant as well as the effect of additive gene action. This result is in agreement with results of Anupam et al, (2) and Aruah et al, (3). The results of Table 3 indicates that the hybrid (K7 × ST) was superior in number of female flowers plant^{-1} , which reached 7.2 female flower.plant^{-1}, while reveald a significant superiority in the number of male flowers plant^{-1}. This could be due to superiority of both parents (ST and K7) by producing the highest number of male flowers (54.3 and 54.0 male flower.plant^{-1}) respectively. While the hybrid of (H1 × ST) was significantly superior in the sex ratio and the fruits set ratio compared to most specific hybrids which reached 14.1% and 58.1% respectively, This could be due to the small number of leaves produced by this hybrid (Table 1), which led to the insects visiting and pollination, as well as the nutritional and physiological status of the plant and the plant content of hormone.These results are in agreement with the results of Anupam et al, (2) and Marxmathi et al (19).

Table 3. flowering growth characteristics of plants and their hybrids of squash (*Cucurbita pepo* L.) and medical pumpkin

Treat.	No. of female flowers / plant	No. of male flowers / plant	Sex ratio	Hold ratio
E1	**12.3**	**43.0**	**28.6**	**67.3**
E2	**12.0**	**48.7**	**24.6**	**49.9**
E3	**12.5**	**36.9**	**33.7**	**56.0**
E 6	**11.4**	**37.0**	**30.9**	**72.8**
K3	**9.7**	**47.4**	**20.4**	**72.6**
K4	**9.3**	**48.0**	**19.4**	**62.9**
K7	**11.0**	**54.3**	**20.2**	**54.3**
H1	**11.7**	**44.7**	**26.2**	**58.0**
MR	**9.7**	**48.7**	**19.9**	**79.4**
ST	**9.0**	**54.0**	**16.6**	**17.4**
ST×E1	**6.5**	**60.7**	**10.8**	**41.6**
ST×E2	**7.0**	**55.3**	**12.6**	**48.5**
E3×ST	**6.2**	**47.0**	**13.1**	**49.7**
E6×ST	**6.5**	**47.1**	**13.8**	**40.0**
K3×ST	**6.6**	**57.3**	**11.6**	**43.0**
ST×K3	**6.7**	**59.7**	**11.2**	**57.6**
K4×ST	**6.3**	**60.3**	**10.5**	**33.8**
K7×ST	**7.2**	**68.0**	**10.6**	**30.5**
H1×ST	**6.8**	**47.3**	**14.4**	**58.1**
ST×H1	**6.5**	**50.7**	**12.8**	**46.6**
MR×ST	**6.0**	**55.7**	**10.8**	**41.4**
L.S.D	**1.55**	**6.667**	**2.712**	**23.78**

The variances among the parent means and the specific hybrids led to the hybrid vigor. The results in Table 4 indicates that the hybrid (K7 × ST) had a positive and significant heterosis in the number of male flowers (26.04), while the hybrid (H1 × ST) without hybrid vigor (0) in the percentage of fruits set. The other hybrids did not gave any positive and significant hybrid vigor in the characters of the sex ratio and the number of female flowers. It could be that the hybrids are under the influence of pairs of over dominance genes. These results are in agreement with results of Davoodi *et al* (8) .

Table 4. Hybrid strength (%) of hybrid flowering growth characteristics of hybrids of squash (*Cucurbita pepo* L.) and medical pumpkin

Treat.	No. of female flowers	No.of male flowers	Sex ratio	Hold ratio
E6×ST	-43.07	-12.74	-55.36	-45.16
ST×H1	-44.07	-6.11	-50.73	-19.21
H1×ST	-41.34	-12.27	-44.72	0.27
E3×ST	-50.65	-12.84	-61.29	-11.46
ST×E2	-40.44	2.65	-48.44	4.17
MR×ST	-40.00	3.24	-45.64	-46.35
K4×ST	-34.63	11.79	-45.49	-46.03
ST×K3	-30.74	10.52	-44.66	-23.44
K3×ST	-31.11	6.19	-42.76	-37.36
ST×E1	-45.58	12.50	-60.84	-30.24
K7×ST	-34.90	26.04	-47.71	-37.67
S.E	1.89	3.79	1.98	5.50

Earliness characters

The results in Table 5 shows a significant differences among the genotypes in earliness characters, the parents E1 and E3 had the lowest number of nodes before the formation of the first female flower reached 11.7 and 10.8 respectively. While , the parents K3 and K7had the lowest period to the female flowering reached 35.7 days and 42.0 days, respectively, which caused the reduction of the number of days from planting to the first harvest process of the K3 parent, recording 40.7 days, while the parent of (ST) was late in the number of nodes before the first female flower, This increased the number of days until the female flowering and the number of days until the first harvest process (16.3 node, 63.0 days and 72.0 days) respectively. These results are in agreement with the results of Doijode (9). The genotypes showed significant differences in earliness characters. The hybrid (E3 × ST) was significantly superior when compared to some hybrids with fewer nodes before the first female flower reached 9.7 nodes. While the hybrid (K7 × ST) was significantly superiored compared to all hybrids in the number of days until the female flowering, which reflected positively on the number of days from planting to the first harvest process (39.7 days and 48.7 days) respectively. This may due to the superiority of squash parents (E3 and K7) in the earliness characters compared to the parent ST, which recorded a delay in the earliness characteristics. These results are in agreement with results Marxmathi (19).

Table 5. Early characteristics of plants and their hybrids of squash (*Cucurbita pepo* L.) and medical pumpkin

Treat.	No. of nodes before the first female flower / plant	No.of days until female flowering	No. of days from planting to the first fairy
E1	11.7	47.3	51.7
E2	13.0	39.7	44.0
E3	10.8	43.7	50.7
E 6	13.3	51.7	57.0
K3	12.0	35.7	40.7
K4	15.9	57.2	61.5
K7	13.0	42.0	50.0
H1	13.7	46.7	51.7
MR	13.0	45.9	51.7
ST	16.3	63.0	72.0
ST×E1	10.3	52.7	60.0
ST×E2	12.0	51.0	58.0
E3×ST	9.7	43.7	52.0
E6×ST	11.1	58.0	64.0
K3×ST	11.0	46.0	55.3
ST×K3	10.0	51.7	55.7
K4×ST	11.2	56.0	62.0
K7×ST	10.3	39.7	48.7
H1×ST	13.3	49.3	66.5
ST×H1	12.0	44.7	59.0
MR×ST	11.3	52.5	57.0
L.S.D	1.67	7.98	8.201

The variances among the parents mean and the specific hybrids led to the hybrid vigor. The results in Table 6 shows that the hybrid (K4 × ST) was able to show the highest negative hybrid vigor relative to the lowest parents by forming the lowest number of nodes before the first female flower. While the hybrid of (ST × H1) had the lowest number of days until the female flowering (-3.04). The hybrid of (K7 × ST) had the lowest number of days from planting to the first harvest process compared to the lowest of parents (-2.96), due to the presence of negative hybrid effect within the characteristics of early development is desirable and subject to the impact genes of over dominance. The presence of negative hybrid vigor within earliness characters is desirable and subject to the over dominance genes in parents. This indicates that these

specific hybrids were earlier than their early parents in the earliness characters, while the positive hybrid vigor refers to the influence of partial dominance genes pairs of parents. This shows that their hybrids had longer durations compared to their earliest parents. These results are in agreement with results of Anupam *et al*, (2); Doijode (9) Hedau and Sirohi, (15).

Table 6. Hybrid strength (%) of Early characteristics of hybrids of squash (*Cucurbita pepo* L.) and medical pumpkin

Treat.	No. of nodes before the first female flower / plant	No.of days until female flowering	No. of days from planting to the first fairy
E6×ST	-16.5	12.36	12.16
ST×H1	-11.3	-3.04	14.61
H1×ST	-1.8	5.93	30.07
E3×ST	-10.2	-0.16	3.37
ST×E2	-7.7	28.36	31.76
MR×ST	-12.5	14.97	10.92
K4×ST	-27.3	-1.89	1.03
ST×K3	-15.5	44.79	36.75
K3×ST	-7.0	30.48	37.65
ST×E1	-11.6	13.56	18.90
K7×ST	-20.2	-2.88	-2.96
S.E	2.1	4.78	4.38

Yield and it is components

The yield is the most important character that the aim of plant breeders seek to produce superior hybrids in terms of the fruit form which determines its component such as the length and diameter of the fruit, the yield of plant, the fruits weight and the number of fruits plant^{-1}, which indicates the physiological and nutritional status of the plant and impact of genetic and environmental conditions on the plant with continuing to study these specific hybrids for their adoption and then distributed to farmers, but in these traits is difficult to find a comparison between the squash parents and the parent of (ST) because of the difference of all measurements of the characters of the two species used in hybridization. The results in Table 7 shows that genotypes of squash parents varied significantly in fruit length, diameter and fruit shape index, but they are still within standard means, indicating good yield quality. The results showed that the parents E3, E6 and K7 were superior when compared to most of the squash plant parents in fruit length (14.8 cm, 16.5 cm and 14.1 cm) respectively and in fruit diameter (4.3 cm, 4.2 cm and 4.3 cm), respectively and their shape index (3.5, 3.9 and 3.4).), respectively. While the standar value was differed in terms of fruit length and diameter and fruit shape index (22.0 cm, 15.5 cm and 1.4) respectively in the parent of (ST) in medical pumpkin compared to the parents of squash. While the parents E1, E6 and K3 produced the highest number of fruits plant^{-1} (8.0, 8.3 , 7.0) respectively, while the parent of (ST) had the lowest number of fruits plant^{-1} (1.6 fruit.plant^{-1}), the most of the squash parents gave marketable fruit weight while the parent of (ST) produsedfruit weight reached 1866.7gm. Squash parents of E3, K3 and MR had the highest value of plant yield of reached 1267.2 gm, 1420.0 gm and 1202.0 gm respectively. This variation in the yield characters that this trait correlated with the number of female flowers, plant length and its branches number, but is subject to the impact of a number of genetic factors, which is affected on the number of fruits produced plant^{-1}. These results are in agreement with the results of other researcher (19). Differences between parents caused significant differences among the specific hybrids, where was found the superiority of the hybrid (ST × E2) in the fruit length (11.9 cm) and the superiority of the hybrid (ST × K3) in fruit diameter (8.6 cm). The superiority of these hybrids could be due to the influence of maternal effect of female parent (ST), as well as the influence of gene action.The hybrid of (MR × ST) had the highest fruit shape index (2.2). This could be due to female parent of (MR) the highest value of fruit diameter (5.0 cm) and the hybrid (ST × K3) showed a significant superiority in the number of fruits plant^{-1} (3.9). fruit weight mean 543.0 gm and plant yield 2011.1 gm.

Table 7. Characteristics of yield and it is components of plants and their hybrids of squash (*Cucurbita pepo* L.) and medical pumpkin

Treat.	No. of fruits Plant $^{-1}$	Fruit length / cm	Diameter of fruit / cm	Fruit form factor	Average fruit weight	yield (g) plant $^{-1}$
E1	8.0	13.6	3.6	3.9	125.7	1008.0
E2	6.0	11.0	4.7	2.3	155.0	935.8
E3	6.8	14.8	4.3	3.5	185.3	1267.2
E 6	8.3	16.5	4.2	3.9	141.7	1180.0
K3	7.0	14.0	3.4	4.1	203.3	1420.0
K4	5.8	13.4	3.7	3.6	172.0	1008.0
K7	6.0	14.1	4.3	3.4	165.3	1002.7
H1	6.8	12.1	4.4	2.8	140.3	949.2
MR	7.7	11.5	5.0	2.5	156.3	1202.0
ST	1.6	22.0	15.5	1.4	1866.7	3016.7
ST×E1	2.7	8.1	6.5	1.3	261.0	729.0
ST×E2	3.5	11.9	6.3	1.9	316.0	1044.0
E3×ST	3.0	11.5	6.4	1.8	281.1	823.2
E6×ST	2.6	10.7	5.9	1.8	243.7	632.7
K3×ST	2.8	9.7	6.6	1.5	283.7	810.8
ST×K3	3.9	11.5	8.6	1.3	543.0	2011.1
K4×ST	2.2	10.3	6.2	1.7	264.2	566.7
K7×ST	2.2	8.5	4.9	1.7	267.7	597.5
H1×ST	4.0	11.1	6.3	1.8	235.0	936.7
ST×H1	3.0	11.0	5.8	1.9	218.0	662.2
R×ST	2.5	8.6	4.0	2.2	264.0	650.7
L.S.D	1.957	3.019	1.331	0.6261	265.7	839.6

It is concluded that most of the improvement of hybrids yield was due to the additive gene action and the over dominance and epistasis (7).

Phytosterol (oil quantity)

The results in Table 8 shows that there are significant differences among the parents and the specific hybrids in the oil properties. The parent of ST was superior in the oil quantity (2.16 gm), the oil percentage (21.70%) and the percentage of the phytosterol concentration (11.84%), while the parent of E2 gave the lowest values in the oil quantity (0.13 gm) and in the phytosterol percentage concentration (6.73% and 1.36%) respectively. The results were higher than found by Gohari *et al*. (11) in squash, Zhana and Ginka (25). The increase in the seeds oil quantity from parent of (ST) could be due to producing the plants with high average number of leaves (68 leaves), which increased the photosynthesis process and that increased oil composition in the seeds. The decreases of the seeds oil quantity, could be due to the influence of environmental factors and its interaction with the genetic factors on the plant, especially in the spring season. The high temperatures lead to decrease in the quantity of oil because the increases of temperature to increases the rate of respiration and therefore does not convert the carbon compounds resulting from photosynthesis to fatty acids, which leads to the lack of oil composition (21). These differences among the parents led to significant differences in the oil characters of its spicific hybrids, where found the superiority of the hybrid of (ST × H1) in the oil quantity and its percentage 2.77 and 27.75% respectively compared to its reciprocal hybrid and other specific hybrids while produced the lowest value in the percentage of phytosterol concentration (1.47%), the hybrids of (ST × E1), (MR×ST) and (ST×K3) were significantly superiored in the percentage of phytosterol concentration which reached 13.15%, 12.26% and 10.74% respectively. While the hybrids of (MR×ST) and (ST× K3) were superiored in the oil percentage reached 21.01% and 17.71% respectively. This could

be due to that the hybrids of (MR×ST) and (ST×K3) had the highest percentage of fruits set, as increasing the fruits set leads to an increase in the number of seeds extracted from it and then increase the oil percentage. While the hybrid (ST×E1) recorded the highest values in plant length and leaf area, which led to an increase in the number of leaves plant^{-1} and then increase the average of photosynthesis and conversion of carbon to fatty acids and increase the oil yield and increase phytosterol. The increase of phytosterol concentration in the plant promotes dense plant growth. These results are in agreement with results of Main-hao,Hu and Ao Yansong (18).

Table 8. Oil quality characteristics of plants and their hybrids of squash (*Cucurbita pepo* L.) and medical pumpkin

Treat.	Oil quantity	Oil %	phytosterol concentration %
E1	0.3283	10.94	4.25
E2	0.1346	6.73	1.36
E3	0.5883	5.88	3.44
E6	1.75229	17.52	2.17
K3	1.5169	15.17	2.89
K4	1.173	23.46	5.1
K7	0.9496	9.50	5.39
H1	1.153	12.81	5.48
MR	0.7504	7.50	4.34
ST	2.1699	21.70	11.84
ST×E1	0.6627	13.25	13.15
ST×E2	1.3515	13.52	6.57
E3×ST	0.1657	5.52	6.42
E6×ST	1.9241	19.24	1.97
K3×ST	1.6249	16.25	4.33
ST×K3	1.7713	17.71	10.74
K4×ST	1.1403	11.40	9.65
K7×ST	1.8801	18.80	5.83
H1×ST	0.5834	14.59	3.08
ST×H1	2.775	27.75	1.47
MR×ST	0.6304	21.01	12.26
S.E	0.15	3.28	0.79

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