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Pre-sowing Seed Chilling Treatment Enhances Fruit Crop Productivity of Pumpkin (*Cucurbita spp.*)*

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Abstract: In previous study conducted in neighboring province (Sohag) it has been noticed that "El-Zarka" (*C. maxima*) Damietta landrace did not flowered, "Connecticut Field cv" (*C. pepo*) flowered but there was no fruit set, while pumpkin landraces (*C. moschata*) produced markedly reduced fruit yield. These results were obtained when planting was done at the regular season dates (middle April). Our current study was carried out at the Experimental Farm of Faculty of Agriculture, Assiut University, Assiut, Egypt, during 2008 and 2009 seasons. Seeds of the aforementioned 3 pumpkin entries were imbibed in tap water for 24 or 36 h and chilled at **4-5 °C** for 10 or 12 d. Results showed that shorter plants with higher sex ratio (female/male) were obtained from seeds imbibed for 36 h and chilled for 12 d. These plants produced greater number of smaller-sized fruits with high TSS % and dry matter in the fruit as compared to fruits of plants from untreated seeds. Such plants gave higher total fruit yield. The overall results substantiate that seed chilling prior to sowing is recommended to produce higher fruit yield and quality in pumpkin under Assiut and/or similar conditions.

Introduction

Production of pumpkin is affected by environmental factors that determine partitioning of assimilate to reproductive tissues (Wien, 1997). Temperature and day length play a dominant role in growth, flower, bud initiation and developing, sex expression and fruit set and development (Devlin and Witham, 1983). Different regional-adapted elite landraces of pumpkin are grown in Egypt but interrupted flowering and fruiting have limited their exchange among various for production areas (Mostafa, 2006 and Wien et al., 2002). Thus, genotypes of pumpkin are greatly differing in growth, sex expression and yield in response to the environment under which they are grown. Therefore, selection of the cultivar and planting date is of great importance in order to

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maximize yield under certain environmental.

In Ithaca, N.Y., Queenstown, Md., and Bradenton, Fla., during the summer (Wien et al., 2002) it has been noticed that the majority of plants of "Howden", "Wizard", and "Baby Bear" formed no fruit on the main stem. They reported that at the hottest location, fruit production of many pumpkin cultivars was delayed and fruit formation decreased. Also, in Egypt, Mostafa (2006), it has been noticed that "El-Zarka" (*C. maxima*) Damietta landrace dose not flower, "Connecticut Field" cv (*C. pepo*) flowered but no fruit setting, while "Kafr El-Battikh" (*C. moschata*) Damietta landrace produces markedly reduced fruit yield. This was true when planting was done at the main production season dated late April. Mostafa (2006) applying 2, 5 and 10 day's seed vernalization at 4-5 °C of pumpkin sown in April showed that plants of the 3 cultivars received 2 or 5 days vernalization continued to grow vegetative bearing flower buds that failed to open. Ten days of seed vernalization induced male and female flower anthesis.

The present study was conducted to determine if exposure of pumpkin seeds to chilling treatment stimulates flowering and enhances productivity when grown in the main season.

Materials and Methods

This study was carried out at the Experimental Farm of Faculty of Agriculture, Assiut University, Assiut, Egypt, during 2008 and 2009.

The experiment treatments were the combinations of the 3 pumpkin cultivars, namely, "El-Zarka" (*C. maxima*) Damietta landrace, "Connecticut Field" cv (*C. pepo*) and "Kafr El-Battikh" (*C. moschata*) Damietta landrace. Seeds of the local pumpkin landrace were obtained from farmers at Damietta province ("El-Zarka" *C. maxima* and "Kafr El-Battikh" *C. moschata*), while the seeds of "Connecticut Field" cv. *C. pepo* were obtained from commercial Heirloom Seeds Company (Washington, USA). Seeds of the 3 pumpkin entries were imbibed in tap water for 24 h or 36 h and subjected to chilling treatments (4-5 °C) for 10 or 12 d. Time of cold treatment were scheduled so as to have cold treated seeds for 10 or 12 day periods simultaneously at the time of sowing (April 15-18th). Seeds for both seasons of the study were from the same seed lots. Two to three seeds (local pumpkin landraces) and one seed (Connecticut Field cv) were planted per hill on ridges 3 m wide and 4 m long. Each plot occupied 12 m^2. Thinning to one plant per hill was practiced twice; the first at the two true-leaf stage and the second one at the 4-5 true-leaf stage. Land preparation and all cultural practice were done as recommended for production of pumpkins. The experiment was laid out as arrangement a split plot in randomized complete blocks with

four replicates. The tested genotypes were in main plot, while treatments of combination of imbibing and chilling seed were randomly distributed to the subplots.

Data were recorded for:

Main vine length (cm), Average content of total or reduced sugar (mg/100g) of fresh leaves fruit, yield in kg per feddan, average fruit weight (kg), number of fruits per plant, sex ratio (female flowers/male flowers), fruit dry matter (DM%), total soluble solids (TSS%) of fruit flesh juice and total carotene content were recorded.

Data of this study was subjected to statically analysis of variance according to Gomez and Gomez (1984) and means were compared using one degree of freedom orthogonal contrast.

Results

No differences were detected for all traits of a given cultivars, whether non-chilled seeds were used dry or imbibed for 24 or 36 h. For convenience, these treatments were presented by a one pooled reference treatment. On the other hand, differences due to pre-sowing seed chilling were significant and showed appreciable interaction with cultivars.

Sugar content determined 30 days after planting was higher in leaves of pumpkin plants raised from chilled seeds than from non-chilled seeds (Table 1). Elevated leaf sugar content was found for plants raised from seeds chilled for 12 days comparing to 10 days. Also, imbibing duration significantly affected the response of seeds to chilling. Table (2) shows that the cultivars differed significantly in the sex ratio (percentage of number of female flowers: the number of male flowers). In both seasons, Kafr El-Battikh was the highest in this regard, while El-Zarka was the lowest. All chilling treatments were better than the non-chilled treatments. The 36 h imbibing/12 d chilling treatment produced the highest percentage of sex ratio. The highest number of female flowers was obtained from Kafe El-Battikh plants, when seeds were imbibed for 36 h and then chilled for 12 d. ANOVA in Table (3) clear indicate that there is significant difference between Kafr El-Battikh and other cultivars in plant (vine) length. No significant difference between El-Zarka and Connecticut Field was found, although the plants of Connecticut Field were longer. Seeds of the three cultivars were significantly affected by the chilling where plants from chilled seeds were shorter than from non-chilled seeds. Plants from seeds imbibed for 36 h and then chilled for 12 d gave plants with the least main vine length.

Data in Table (4) clearly show that the cultivars differed greatly in number of fruits/plant. Cultivars were differentially responded to chilling. Kafr El-Battikh exhibited a quantitative

pattern of response to chilling. Chilling and non chilling treatments in this cv gave fruits. Fruits number seemed to increase with increasing chilling period. The highest number of fruits / plant was obtained from Kafr El-Battikh plants, when seeds were imbibed for 36 h and then chilled for 12 d. Connecticut Field pumpkin cv exhibited a qualitative pattern of response to chilling, where it did not respond except when seeds were treated for 12 d chilling after being imbibed for 36 h. However, El-Zarka cv exhibited a qualitative and a quantitative pattern of response to chilling. The qualitative response was that the non-chilled treatments gave no fruits, while all chilled treatments produced fruits. The three cultivars were greatly affected by seed chilling with regard to average weight of fruit (Table 5). The lowest average weight of fruits was produced from seeds imbibed for 36 h and then chilled for 12 d. The data in Table (6) show that differences among the 3 cultivars in fruit yield were affected by seeds chilling treatment. There was a quantitative and qualitative effect for the seeds treatments on fruit yield. The greatest fruit yield was produced from seeds of Kafr El-Battikh imbibed for 36 h and then chilled for 12 d.

Data presented in Table (7) indicated that the differences among cultivars in the fruit content of total soluble solids (TSS %) were significant. Seeds chilling were a great influence in the TSS % in the fruit. The highest content of TSS in fruit was obtained from Kafr El-Battikh plants obtained from seeds imbibed for 36 h and then chilled for 12d. The carotene content in fruit (mg / 100 g fresh fruit flesh) is one of the important qualities; this is because of the value of the health-carotene as a subject from antioxidants. Data in Table (8) indicated that the three cultivars in study differed greatly in fruit content of carotene. Treatments of chilling had a great influence and differed in fruit carotene content. The highest fruit content of carotene (mg/100g of fresh fruit flesh) was obtained from fruits of Kafr El-Battikh produced from the seeds that were treated before planting with 36-h imbibing and then 12 d chilling. The trend in the percentage of dry matter in fruits was similar to the character of carotene and TSS. Data presented in Table (9) clearly show that highly significant differences among the three cultivars were found in this respect. The highest percentage of dry matter in fruits was obtained from the seeds of Kafr El-Battikh, which treated a 36 h imbibing and then chilled for 12 d in refrigerator at 4-5 °C.

Discussion:

The present data indicate that cultivars differentially responded to chilling. Kafr El-Battikh exhibited a quantitative pattern of response to chilling. All seed chilling treatments gave fruit yield. Fruit yield was higher with increasing chilling period. The

highest yield was obtained from seeds of Kafr El-Battikh imbibed for 36 hours and chilled for 12 days. All seed chilling treatments were better than control (non-chilled). Connecticut Field cv exhibited a qualitative pattern of response to chilling, where it did not respond except when seeds were treated for 12 d chilling after being imbibed for 36 h. However, El-Zarka exhibited a qualitative and a quantitative pattern of response to chilling. The qualitative response was that the non-chilled treatments gave no fruits, while all chilled treatments produced fruits. Devlin (1966) reported that cold requirement in some plant spp. is qualitative, in other species may be quantitative. Analysis of sugars in leaves indicated that chilling treatments were affected on the product in all cultivars. Correlation between yield and sugars content in leaf indicated that the chilling treatments have an effect on the production and transmission of sugars. It appears that they limit the movement of sugars to the roots and thus accumulation in the shoots. The treatments which gave a high yield were of shorter plants. With increase span of chilling, yield of fruit was increased and the plants were shorter. Treatments that did not give the fruit yield, plants are the longest. Summerfield *et al.* (1989) noted that vernalization has been defined as the hastening of flowering by temperature cooler than those optimal for growth but can be extended to include a wide range of physiological responses e.g., changes in height, node number and determinate growth habit. In addition to the influence of chilling treatment on the fruit yield was also affecting the quality of the fruit. When the proportion of female flowers to the male was increased, the number of fruit per plant was increased. Also, the high number of fruits on the plant reduced the average weight of the fruit, with have high quality (high concentration of dry matter and content of carotene and TSS). Chilling treatments, in addition, have had a salutary effect (an increase of carotene content of fruits). A content of antioxidant (carotene) substances in fruit was increased. It seems that those treatments as produced antioxidants and increased content of plants to make this resistance to stresses. Part of the increased productivity of the chilling treatments may be is not only their effect on the production of sugars, but also the production of antioxidants. This probably led to the protection of chloroplast conditions unfavorable this has led to greater efficiency in construction compared to the one that did not produce in cells large amounts of antioxidants. Increase the efficiency of chloroplasts in construction led to the increase of manufactured (sugars) goods within the cell, and this led to higher fruit yields.

There are many previous researches that are consistent with the present study. They reported that the chilling lead to crop improvement (Dennis et al., 1996, Reeves and Coupland, 2000, Sheldon et al., 2000, Clough et al., 2001, Wien et al., 2002, Amasino, 2004, Song and Amasino, 2004, Amasino, 2005). It should be noted that the treatment of the chilling process is vernalization. Plant physiologists, for example Chourad and Poignant (1951) differentiate between the vernalization phenomenon and the direct effect of low temperature and flower initiation. In case the flower primordial occurs at time of cold treatment exposure, not after, this is a low temperature direct effect. On the other hand, vernalization prepare the plant to flower only, but not induce flower initiation at the time of exposure, so the effect of low temperature on flowering by vernalization is postponed, delayed or after effect. However, the optimum temperature for vernalization depends on the genetic constitution and the period of exposure to low treatment. It is not clear what it is we have a real, which makes chilling influence on the amount of yield and quality can guess that the chilling effect on the accumulation and transfer among members of plant sugars and improvement here chilling effect may be due to reduce the transmission of photosynthetic sugars to the roots and thus make it accessible to fruition in the plant and associated with the response provided by the higher proportion of sexual and contract due to higher availability of the necessary sugars for this process. In previous studies in summer squash Refai and Mohamed (2009) showed that the tendency towards the production of female flowers appear to more, genetic improvement has been possible to have elections, and they noted that an increase in productivity female with associated qualities floral morphology (shorter plants and less number of leaves), which makes the plant species suitable for intensive agriculture optimized use of land with improvement ranging from 30 - 50% in fruit yield. This is also compatible with what is found in our study where the effect of the child led to the production of plants with a shorter main vine than plants obtained from non-chilled. These plants also gave a higher yield. So we can say that the process of seed chilling can be alternative means, such as improvement. In these studies it could be assumed that transactions chilling led to the activation of some genes or genetic factors. This activation was either by direct or indirect effect. Act may be an indirect effect of sugars formed in the cells on the genetic signals as stated in many studies (Graham, 1996; Jang and Sheen, 1997; Smeekens and Rook, 1997; Smeekens, 1998). However, there remains a lack of clarity in the interpretation of transactions chilling and imbibing. Chilling is associated with

increased GA, and GA associated with increased male flowers in squash having real chilling effect in this study indicates and suggesting that chilling is useful in the production of agricultural pumpkin in the main season and which corresponds in Egypt with the longer day and high temperature and that conflict with the pumpkin flowering or fruiting. Penaranda *et al.,* (2007) pointed that high temperatures in the Spring-Summer growing season induced maleness in all the cultivars analyzed, delaying the production of female flowers, and increasing the number of male flowers on the main stem. Indeed, those flowers that remained attached to harvested zucchini fruits were transformed into bisexual flowers, exhibiting different degrees of stamen development, and were arrested as immature, closed floral buds. Metwally (2003) studied the response of some broad bean lines to some chilling treatments, he reported that freezing of the mother seeds resulted in progress toward flowering and this trend was correlated with high seed yield. Moreover, seeds chilling can be used to exchange landraces and cultivation anywhere after seeds treat. In addition to maximize the agricultural production is to reduce wastage during handling has been controlling the size of the fruit and this may be useful to suit the use of small group of customers.

This study suggests that exposure of plants to stress conditions earlier as seed chilling (vernalization) stimulates flowering and enhances productivity and that seems to be through their effects on the behavior of sugars accumulation /translocation in plants.

Table (1): Average content of total or reduced sugar (mg/100g) of fresh leaves (30 days after sowing date) produced from untreated and imbibed pumpkin seeds for 24 or 36 h and chilled for 10 or 12 days at 4-5 ^{o}C during 2008 and 2009[a].

Chilling treatments \ Cultivars		Kafr El-Battikh (cv1)	El-Zarka (cv2)	Connecticut Field (cv3)	Mean
		2008			
Imbibed without chilling	**Untreated**	34.80	6.89	7.88	**16.53**
	24 h	35.10	6.75	8.22	**16.69**
	36 h	35.31	6.96	8.12	**16.80**
Pooled reference treat.		35.07	6.87	8.08	**16.67**
Imbibed and Chilled	**24 h/10 d**	45.15	9.03	13.16	**22.44**
	24 h/12 d	56.85	10.72	14.67	**27.42**
	36 h/10 d	46.24	9.85	13.61	**23.23**
	36 h/12 d	58.05	11.02	14.71	**27.93**
	Mean	**48.27**	**9.49**	**12.85**	**23.54**
		2009			
Imbibed without chilling	**Untreated**	36.34	7.19	8.23	**17.25**
	24 h	36.64	7.05	8.59	**17.43**
	36 h	36.86	7.27	8.48	**17.54**
Pooled reference treat.		36.61	7.17	8.43	**17.41**
Imbibed and Chilled	**24 h/10 d**	47.13	9.42	13.74	**23.43**
	24 h/12 d	59.36	11.19	15.32	**28.62**
	36 h/10 d	48.28	10.28	14.21	**24.26**
	36 h/12 d	60.61	11.50	15.36	**29.15**
	Mean	**5040**	**9.91**	**13.41**	**24.57**

S.V.	D.F	F[(b)] (2008)	F (2009)
Replicates	3	**n.s.**	**n.s.**
Cultivars (cv)	2	**	**
cv1 vs. cv 2 + cv 3	1	**	**
cv2 vs. cv3	1	**	**
Error a	6		
Imbibing & Chilling	4	**	**
(chilled) vs. (non-chilled)	1	**	**
(10 d) vs. (12 d)	1	**	**
(24 h/ 10 d) vs. (36 h/ 12 d)	1	**	**
(24 h 12 d) vs. (36 h 12 d)	1	**	**
Cultivars x Imbibing & Chilling	8	**	**
(chilled) vs. (non-chilled) x cv	2	**	**
(10 d) vs. (12 d) x cv	2	**	**
(24 h/ 10 d) vs. (36 h/ 10 d) x cv	2	**n.s.**	**n.s.**
(24 h 12 d) vs. (36 h 12 d) x cv	2	**	**
Error b	36		

[a] variance of cultivar x chilling treatments x year interaction was significant.
[b] n.s., *, ** nonsignificant and significant at P= 0.05 or 0.01, respectively.
[c] differences among non-chilled seeds were not significant.

Table (2): Average sex ratio (%) produced from untreated and imbibed pumpkin seeds for 24 or 36 h and chilled for 10 or 12 days at 4-5 ^{O}C during 2008 and 2009[(a)].

Chilling treatments	Cultivars	Kafr El-Battikh (cv1)	El-Zarka (cv2)	Connecticut Field (cv3)	Mean
		2008			
Imbibed without chilling	**Untreated**	6.40	0.00	4.60	**3.67**
	Imbibed 24 h	6.50	0.00	4.63	**3.71**
	Imbibed 36 h	6.55	0.00	4.63	**3.73**
Pooled reference treat.		6.48	0.00	4.62	**3.70**
Imbibed and Chilled	**24 h/10 d**	7.99	5.33	5.38	**6.23**
	24 h/12 d	9.01	6.50	5.65	**7.05**
	36 h/10 d	8.30	5.48	5.55	**6.44**
	36 h/12 d	9.33	6.75	5.89	**7.32**
	Mean	**8.22**	**4.81**	**5.42**	**6.15**
		2009			
Imbibed without chilling	**Untreated**	6.09	0.00	4.30	**3.46**
	Imbibed 24 h	6.19	0.00	4.58	**3.59**
	Imbibed 36 h	6.24	0.00	4.56	**3.60**
Pooled reference treat.		6.17	0.00	4.48	**3.55**
Imbibed and Chilled	**24 h/10 d**	7.68	5.03	5.31	**6.00**
	24 h/12 d	8.70	6.19	5.35	**6.75**
	36 h/10 d	7.98	5.14	5.25	**6.12**
	36 h/12 d	9.00	6.43	5.59	**7.00**
	Mean	**7.90**	**4.56**	**5.20**	**5.89**

S.V.	D.F	F[(b)] (2008)	F (2009)
Replicates	3	**n.s.**	**n.s.**
Cultivars (cv)	2	**	**
cv1 vs. cv 2 + cv 3	1	**	**
cv2 vs. cv3	1	*	*
Error a	6		
Imbibing & Chilling	4	**	**
(chilled) vs. (non-chilled)	1	**	**
(10 d) vs. (12 d)	1	**	**
(24 h/ 10 d) vs. (36 h/ 10 d)	1	**	**n.s.**
(24 h 12 d) vs. (36 h 12 d)	1	**	**
Cultivars x Imbibing & Chilling	8	**	**
(chilled) vs. (non-chilled) x cv	2	**	**
(10 d) vs. (12 d) x cv	2	**	**
(24 h/ 10 d) vs. (36 h/ 10 d) x cv	2	**n.s.**	**n.s.**
(24 h 12 d) vs. (36 h 12 d) x cv	2	**n.s.**	**n.s.**
Error b	36		

[a] variance of cultivar x chilling treatments x year interaction was significant.
[b] n.s., *, ** nonsignificant and significant at P= 0.05 or 0.01, respectively.
[c] differences among non-chilled seeds were not significant.

Table (3): Average length of plant (cm) produced from untreated and imbibed pumpkin seeds for 24 or 36 h and chilled for 10 or 12 days at 4-5 °C during 2008 and 2009[a].

Chilling treatments \ Cultivars		Kafr El-Battikh (cv1)	El-Zarka (cv2)	Connecticut Field (cv3)	Mean
		2008			
Imbibed without chilling	**Untreated**	300.9	324.1	339.3	**321.4**
	Imbibed 24 h	299.4	322.5	337.6	**319.8**
	Imbibed 36 h	300.0	323.1	338.2	**320.4**
Pooled reference treat.		300.1	323.2	338.4	**320.5**
Imbibed and Chilled	**24 h/10 d**	294.9	317.6	332.5	**315.0**
	24 h/12 d	276.8	298.2	312.1	**295.7**
	36 h/10 d	285.8	307.9	322.3	**305.3**
	36 h/12 d	270.8	291.7	305.3	**289.3**
	Mean	**285.7**	**307.7**	**322.1**	**305.2**
		2009			
Imbibed without chilling	**Untreated**	286.8	313.4	325.1	**308.4**
	Imbibed 24 h	285.4	311.8	323.4	**306.9**
	Imbibed 36 h	286.0	312.4	324.1	**307.5**
Pooled reference treat.		286.1	312.5	324.2	**307.6**
Imbibed and Chilled	**24 h/10 d**	281.1	307.1	318.6	**302.2**
	24 h/12 d	263.9	288.3	299.1	**283.7**
	36 h/10 d	272.5	297.7	308.8	**293.0**
	36 h/12 d	258.1	282.0	292.6	**277.6**
	Mean	**272.3**	**297.5**	**308.6**	**292.8**

S.V.	D.F	F[b] (2008)	F (2009)
Replicates	3	**n.s.**	**n.s.**
Cultivars (cv)	2	**	**
cv1 vs. cv 2 + cv 3	1	**	**
cv2 vs. cv3	1	**n.s.**	**n.s.**
Error a	6		
Imbibing & Chilling	4	**	**
(chilled) vs. (non-chilled)	1	**	**
(10 d) vs. (12 d)	1	**	**
(24 h/ 10 d) vs. (36 h/ 10 d)	1	**	**
(24 h 12 d) vs. (36 h 12 d)	1	**	**
Cultivars x Imbibing & Chilling	8	**	**
(chilled) vs. (non-chilled) x cv	2	**	**
(10 d) vs. (12 d) x cv	2	**	**
(24 h/ 10 d) vs. (36 h/ 10 d) x cv	2	**n.s.**	**
(24 h 12 d) vs. (36 h 12 d) x cv	2	**n.s.**	**n.s.**
Error b	36		

[a] variance of cultivar x chilling treatments x year interaction was significant.
[b] n.s., *, ** nonsignificant and significant at P= 0.05 or 0.01, respectively.
[c] differences among non-chilled seeds were not significant.

Table (4): Average number of fruits per plant produced from untreated and imbibed pumpkin seeds for 24 or 36 h and chilled for 10 or 12 days at 4-5 °C during 2008 and 2009[a].

Chilling treatments	Cultivars	Kafr El-Battikh (cv1)	El-Zarka (cv2)	Connecticut Field (cv3)	Mean
		2008			
Imbibed without chilling	**Untreated**	6.3	0.0	0.0	**2.1**
	Imbibed 24 h	5.8	0.0	0.0	**1.9**
	Imbibed 36 h	6.4	0.0	0.0	**2.1**
Pooled reference treat.		6.1	0.0	0.0	**2.0**
Imbibed and Chilled	**24 h/10 d**	4.9	1.5	0.0	**2.1**
	24 h/12 d	7.8	2.8	0.0	**3.6**
	36 h/10 d	5.1	2.0	0.0	**2.4**
	36 h/12 d	7.7	3.1	2.0	**4.3**
	Mean	**6.3**	**1.9**	**0.4**	**2.9**
		2009			
Imbibed without chilling	**Untreated**	4.0	0.0	0.0	**1.3**
	Imbibed 24 h	4.5	0.0	0.0	**1.5**
	Imbibed 36 h	4.4	0.0	0.0	**1.5**
Pooled reference treat.		4.3	0.0	0.0	**1.4**
Imbibed and Chilled	**24 h/10 d**	3.9	1.5	0.0	**1.8**
	24 h/12 d	5.8	2.3	0.0	**2.7**
	36 h/10 d	4.5	2.2	0.0	**2.2**
	36 h/12 d	7.3	2.8	1.3	**3.8**
	Mean	**5.1**	**1.8**	**0.3**	**2.4**

S.V.	D.F	F[b] (2008)	F (2009)
Replicates	3	**n.s.**	**n.s.**
Cultivars (cv)	2	**	**
cv1 vs. cv 2 + cv 3	1	**	**
cv2 vs. cv3	1	**	**
Error a	6		
Imbibing & Chilling	4	**	**
(chilled) vs. (non-chilled)	1	**	**
(10 d) vs. (12 d)	1	**	**
(24 h/ 10 d) vs. (36 h/ 10 d)	1	**n.s.**	**n.s.**
(24 h 12 d) vs. (36 h 12 d)	1	**	**
Cultivars x Imbibing & Chilling	8	**	**
(chilled) vs. (non-chilled) x cv	2	**	**
(10 d) vs. (12 d) x cv	2	**	**
(24 h/ 10 d) vs. (36 h/ 10 d) x cv	2	**n.s.**	**n.s.**
(24 h 12 d) vs. (36 h 12 d) x cv	2	**	**n.s.**
Error b	36		

[a] variance of cultivar x chilling treatments x year interaction was significant.

[b] n.s., *, ** nonsignificant and significant at P= 0.05 or 0.01, respectively.

[c] differences among non-chilled seeds were not significant.

Table (5): Average weight of fruit (kg) produced from untreated and imbibed pumpkin seeds for 24 or 36 h and chilled for 10 or 12 days at 4-5 ^{O}C during 2008 and 2009[a].

Chilling treatments \ Cultivars		Kafr El-Battikh (cv1)	El-Zarka (cv2)	Connecticut Field (cv3)	Mean
		2008			
Imbibed without chilling	**Untreated**	10.321	0.000	0.000	**3.440**
	Imbibed 24 h	10.338	0.000	0.000	**3.446**
	Imbibed 36 h	10.442	0.000	0.000	**3.481**
Pooled reference treat.		10.367	0.000	0.000	**3.456**
Imbibed and Chilled	**24 h/10 d**	9.495	1.395	0.000	**3.630**
	24 h/12 d	6.425	1.363	0.000	**2.596**
	36 h/10 d	9.289	1.419	0.000	**3.569**
	36 h/12 d	6.073	1.250	0.461	**2.595**
	Mean	**8.330**	**1.085**	**0.092**	**3.169**
		2009			
Imbibed without chilling	**Untreated**	10.552	0.000	0.000	**3.517**
	Imbibed 24 h	9.640	0.000	0.000	**3.213**
	Imbibed 36 h	10.249	0.000	0.000	**3.416**
Pooled reference treat.		10.147	0.000	0.000	**3.382**
Imbibed and Chilled	**24 h/10 d**	9.566	1.412	0.000	**3.659**
	24 h/12 d	6.762	1.039	0.000	**2.601**
	36 h/10 d	9.494	1.171	0.000	**3.555**
	36 h/12 d	6.609	1.086	0.391	**2.695**
	Mean	**8.516**	**0.942**	**0.078**	**3.178**

S.V.	D.F	F[b] (2008)	F (2009)
Replicates	3	**n.s.**	**n.s.**
Cultivars (cv)	2	**	**
cv1 vs. cv 2 + cv 3	1	**	**
cv2 vs. cv3	1	**	**
Error a	6		
Imbibing & Chilling	4	**	**
(chilled) vs. (non-chilled)	1	**	**
(10 d) vs. (12 d)	1	**	**
(24 h/ 10 d) vs. (36 h/ 10 d)	1	**n.s.**	**n.s.**
(24 h 12 d) vs. (36 h 12 d)	1	**	**n.s.**
Cultivars x Imbibing & Chilling	8	**	**
(chilled) vs. (non-chilled) x cv	2	**	**
(10 d) vs. (12 d) x cv	2	**	**
(24 h/ 10 d) vs. (36 h/ 10 d) x cv	2	**n.s.**	**n.s.**
(24 h 12 d) vs. (36 h 12 d) x cv	2	**n.s.**	**
Error b	36		

[a] variance of cultivar x chilling treatments x year interaction was significant.
[b] n.s., *, ** nonsignificant and significant at P= 0.05 or 0.01, respectively.
[c] differences among non-chilled seeds were not significant.

Table (6): Total fruit yield (kg/m^2) produced from untreated and imbibed pumpkin seeds for 24 or 36 h and chilled for 10 or 12 days at 4-5 ^{o}C during 2008 and 2009[a].

Chilling treatments		Cultivars: Kafr El-Battikh (cv1)	El-Zarka (cv2)	Connecticut Field (cv3)	Mean
		2008			
Imbibed without chilling	**Untreated**	10.240	0.000	0.000	**3.413**
	Imbibed 24 h	10.449	0.000	0.000	**3.483**
	Imbibed 36 h	10.554	0.000	0.000	**3.518**
Pooled reference treat.		10.414	0.000	0.000	**3.471**
Imbibed and Chilled	**24 h/10 d**	11.110	0.507	0.000	**3.872**
	24 h/12 d	11.984	0.921	0.000	**4.302**
	36 h/10 d	11.235	0.674	0.000	**3.970**
	36 h/12 d	12.483	0.917	0.226	**4.542**
	Mean	**11.445**	**0.604**	**0.045**	**4.031**
		2009			
Imbibed without chilling	**Untreated**	10.650	0.000	0.000	**3.550**
	Imbibed 24 h	10.868	0.000	0.000	**3.623**
	Imbibed 36 h	10.978	0.000	0.000	**3.659**
Pooled reference treat.		10.832	0.000	0.000	**3.611**
Imbibed and Chilled	**24 h/10 d**	11.555	0.669	0.000	**4.075**
	24 h/12 d	12.464	0.752	0.000	**4.406**
	36 h/10 d	11.685	0.712	0.000	**4.133**
	36 h/12 d	12.984	0.818	0.152	**4.651**
	Mean	**11.904**	**0.590**	**0.030**	**4.175**

S.V.	D.F	F[(b)] (2008)	F (2009)
Replicates	3	**n.s.**	**n.s.**
Cultivars (cv)	2	**	**
cv1 vs. cv 2 + cv 3	1	**	**
cv2 vs. cv3	1	**n.s.**	**n.s.**
Error a	6		
Imbibing & Chilling	4	**	**
(chilled) vs. (non-chilled)	1	**	**
(10 d) vs. (12 d)	1	**	**
(24 h/ 10 d) vs. (36 h/ 10 d)	1	*	**n.s.**
(24 h 12 d) vs. (36 h 12 d)	1	**	**
Cultivars x Imbibing & Chilling	8	**	**
(chilled) vs. (non-chilled) x cv	2	**	**
(10 d) vs. (12 d) x cv	2	**	**
(24 h/ 10 d) vs. (36 h/ 10 d) x cv	2	**n.s.**	**n.s.**
(24 h 12 d) vs. (36 h 12 d) x cv	2	**	**
Error b	36		

[a] variance of cultivar x chilling treatments x year interaction was significant.
[b] n.s., *, ** nonsignificant and significant at P= 0.05 or 0.01, respectively.
[c] differences among non-chilled seeds were not significant.

Table (7): Average total soluble solids (TSS %) of fresh fruit flesh produced from untreated and imbibed pumpkin seeds for 24 or 36 h and chilled for 10 or 12 days at 4-5 ^{O}C during 2008 and 2009[a].

Chilling treatments	Cultivars	Kafr El-Battikh (cv1)	El-Zarka (cv2)	Connecticut Field (cv3)	Mean
		2008			
Imbibed without chilling	**Untreated**	5.4	0.0	0.0	**1.8**
	Imbibed 24 h	5.6	0.0	0.0	**1.9**
	Imbibed 36 h	5.5	0.0	0.0	**1.8**
Pooled reference treat.		5.5	0.0	0.0	**1.8**
Imbibed and Chilled	**24 h/10 d**	6.4	5.6	0.0	**4.0**
	24 h/12 d	7.0	6.3	0.0	**4.4**
	36 h/10 d	6.5	6.1	0.0	**4.2**
	36 h/12 d	7.3	6.4	6.3	**6.6**
	Mean	**6.5**	**4.9**	**1.3**	**4.2**
		2009			
Imbibed without chilling	**Untreated**	5.5	0.0	0.0	**1.8**
	Imbibed 24 h	5.7	0.0	0.0	**1.9**
	Imbibed 36 h	5.6	0.0	0.0	**1.9**
Pooled reference treat.		5.6	0.0	0.0	**1.9**
Imbibed and Chilled	**24 h/10 d**	6.4	5.7	0.0	**4.0**
	24 h/12 d	7.1	6.3	0.0	**4.4**
	36 h/10 d	6.6	6.2	0.0	**4.2**
	36 h/12 d	7.4	6.4	6.3	**6.7**
	Mean	**6.6**	**4.9**	**1.3**	**4.3**

S.V.	D.F	F[b] (2008)	F (2009)
Replicates	3	**n.s.**	**n.s.**
Cultivars (cv)	2	**	**
cv1 vs. cv 2 + cv 3	1	**	**
cv2 vs. cv3	1	**	**
Error a	6		
Imbibing & Chilling	4	**	**
(chilled) vs. (non-chilled)	1	**	**
(10 d) vs. (12 d)	1	**	**
(24 h/ 10 d) vs. (36 h/ 10 d)	1	**n.s.**	**n.s.**
(24 h 12 d) vs. (36 h 12 d)	1	**	**
Cultivars x Imbibing & Chilling	8	**	**
(chilled) vs. (non-chilled) x cv	2	**	**
(10 d) vs. (12 d) x cv	2	**	**
(24 h/ 10 d) vs. (36 h/ 10 d) x cv	2	**n.s.**	**n.s.**
(24 h 12 d) vs. (36 h 12 d) x cv	2	**	**
Error b	36		

[a] variance of cultivar x chilling treatments x year interaction was significant.
[b] n.s., *, ** nonsignificant and significant at P= 0.05 or 0.01, respectively.
[c] differences among non-chilled seeds were not significant.

Table (8): Average content of carotene (mg/100g) of fresh fruit flesh produced from untreated and imbibed pumpkin seeds for 24 or 36 h and chilled for 10 or 12 days at 4-5 ^{O}C during 2008 and 2009[a].

Chilling treatments		Cultivars: Kafr El-Battikh (cv1)	El-Zarka (cv2)	Connecticut Field (cv3)	Mean
		2008			
Imbibed without chilling	Untreated	17.5	0.0	0.0	5.8
	Imbibed 24 h	18.1	0.0	0.0	6.0
	Imbibed 36 h	17.9	0.0	0.0	6.0
Pooled reference treat.		1.8	0.0	0.0	5.9
Imbibed and Chilled	24 h/10 d	20.6	16.3	0.0	12.3
	24 h/12 d	22.6	18.1	0.0	13.6
	36 h/10 d	21.0	17.7	0.0	12.9
	36 h/12 d	23.6	18.4	19.6	20.5
	Mean	21.1	14.1	3.9	13.0
		2009			
Imbibed without chilling	Untreated	17.6	0.0	0.0	5.9
	Imbibed 24 h	18.3	0.0	0.0	6.1
	Imbibed 36 h	18.0	0.0	0.0	6.0
Pooled reference treat.		18.0	0.0	0.0	6.0
Imbibed and Chilled	24 h/10 d	20.7	16.3	0.0	12.4
	24 h/12 d	22.8	18.2	0.0	13.7
	36 h/10 d	21.2	17.8	0.0	13.0
	36 h/12 d	23.8	18.6	19.3	20.6
	Mean	21.3	14.2	3.9	13.1

S.V.	D.F	F[b] (2008)	F (2009)
Replicates	3	n.s.	n.s.
Cultivars (cv)	2	**	**
cv1 vs. cv 2 + cv 3	1	**	**
cv2 vs. cv3	1	**	**
Error a	6		
Imbibing & Chilling	4	**	**
(chilled) vs. (non-chilled)	1	**	**
(10 d) vs. (12 d)	1	**	**
(24 h/ 10 d) vs. (36 h/ 10 d)	1	n.s.	n.s.
(24 h 12 d) vs. (36 h 12 d)	1	**	**
Cultivars x Imbibing & Chilling	8	**	**
(chilled) vs. (non-chilled) x cv	2	**	**
(10 d) vs. (12 d) x cv	2	**	**
(24 h/ 10 d) vs. (36 h/ 10 d) x cv	2	n.s.	n.s.
(24 h 12 d) vs. (36 h 12 d) x cv	2	**	**
Error b	36		

[a] variance of cultivar x chilling treatments x year interaction was significant.
[b] n.s., *, ** nonsignificant and significant at P= 0.05 or 0.01, respectively.
[c] differences among non-chilled seeds were not significant.

Table (9): Average dry matter (DM %) of fresh fruit flesh produced from untreated and imbibed pumpkin seeds for 24 or 36 h and chilled for 10 or 12 days at 4-5 ^{O}C during 2008 and 2009[a].

Chilling treatments \ Cultivars		Kafr El-Battikh (cv1)	El-Zarka (cv2)	Connecticut Field (cv3)	Mean
		2008			
Imbibed without chilling	Untreated	6.6	0.0	0.0	2.2
	Imbibed 24 h	6.8	0.0	0.0	2.3
	Imbibed 36 h	6.7	0.0	0.0	2.2
Pooled reference treat.		6.7	0.0	0.0	2.2
Imbibed and Chilled	24 h/10 d	7.8	6.7	0.0	4.8
	24 h/12 d	8.5	7.4	0.0	5.3
	36 h/10 d	7.9	7.3	0.0	5.1
	36 h/12 d	8.9	7.6	7.3	7.9
	Mean	7.9	5.8	1.5	5.1
		2009			
Imbibed without chilling	Untreated	6.6	0.0	0.0	2.2
	Imbibed 24 h	6.8	0.0	0.0	2.3
	Imbibed 36 h	6.8	0.0	0.0	2.3
Pooled reference treat.		6.7	0.0	0.0	2.2
Imbibed and Chilled	24 h/10 d	7.7	6.5	0.0	4.8
	24 h/12 d	8.6	7.2	0.0	5.3
	36 h/10 d	7.9	7.0	0.0	5.0
	36 h/12 d	8.9	7.3	7.4	7.9
	Mean	8.0	5.6	1.5	5.0

S.V.	D.F	F[b] (2008)	F (2009)
Replicates	3	n.s.	n.s.
Cultivars (cv)	2	**	**
cv1 vs. cv 2 + cv 3	1	**	**
cv2 vs. cv3	1	**	**
Error a	6		
Imbibing & Chilling	4	**	**
(chilled) vs. (non-chilled)	1	**	**
(10 d) vs. (12 d)	1	**	**
(24 h/ 10 d) vs. (36 h/ 10 d)	1	n.s.	n.s.
(24 h 12 d) vs. (36 h 12 d)	1	**	**
Cultivars x Imbibing & Chilling	8	**	**
(chilled) vs. (non-chilled) x cv	2	**	**
(10 d) vs. (12 d) x cv	2	**	**
(24 h/ 10 d) vs. (36 h/ 10 d) x cv	2	n.s.	n.s.
(24 h 12 d) vs. (36 h 12 d) x cv	2	**	**
Error b	36		

[a] variance of cultivar x chilling treatments x year interaction was significant.
[b] n.s., *, ** nonsignificant and significant at P= 0.05 or 0.01, respectively.
[c] differences among non-chilled seeds were not significant.

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معاملات تبريد البذور قبل الزراعة تحسن من انتاجية القرع العسلي

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في دراسة سابقة بمحافظة مجاورة (سوهاج) قيمت سلالات و أصناف من القرع العسلي في عدة مواعيد زراعية (منتصف كلا من مارس و أبريل و أغسطس و سبتمبر). وأوضحت الدراسة أن السلالة الزرقا (سلالة ارضية من القرع العسلي بمحافظة دمياط) لم تزهر، وأن الصنف (Connecticut Field) أزهر و لكن ازهاره لم تعقد، بينما السلالة كفر البطيخ (سلالة ارضية من القرع العسلي بمحافظة دمياط) انتجت محصول منخفض. هذا عند الزراعة في المواعيد العادية (منتصف ابريل). تمت دراستنا الحالية بالمزرعة البحثية، كلية الزراعة، جامعة اسيوط، اسيوط، مصر خلال 2008 و 2009 و فيها تم نقع بذور الثلاث مدخلات من القرع العسلي السابقة الذكر في ماء الصنبور لمدة 24 أو 36 ساعة ثم بردت (4-5 °م) لمدة 10 أو 12 يوم. وجد أن أقصر النباتات مع أعلي نسبة جنسية (أزهار مؤنثة/أزهار مذكرة) كانت من البذور التي نقعت لمدة 36 ساعة و بردت لمدة 12 يوم. هذه النباتات انتجت أكبر عدد من الثمار صغيرة الحجم ذات محتوي مرتفع من المادة الجافة و المادة الصلبة الذائبة الكلية بالثمار. تلك النباتات أنتجت أعلي محصول كلي من الثمار، ومن اجمالي النتائج توصي الدراسة بتبريد بذور القرع العسلي قيد الدراسة قبل الزراعة لإنتاج أفضل محصول ثمري كماً و جودة تحت ظروف أسيوط و أي ظروف مشابهة