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STUDIES ON YIELD AND STORABILITY OF BABY CORN EARS

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ABSTRACT

Two field experiments were carried out during summer and nili seasons of 1999 and 2000 to achieve a study on ear characters, total yield and its components and storability of baby ears obtained from three corn cultivars ,i.e., field corn, sweet corn and true baby corn.

Results revealed that field corn cultivar had the best ear characters, followed by baby corn cultivar, and then sweet corn at last.

Suitable harvest date to produce baby ears found to be at silking for both field corn and sweet corn, and one and two days after silking for true baby corn .

True baby corn produced the highest of number of baby ears per plant. and subsequently the highest husked and unhusked marketable yield followed by sweet corn, then field corn was the last.

In the storability study, weight loss and decay percentage were increased while, visual quality and chemical characters declined gradually as the storage time progressed.

Cultivars can be ranked as very good (field corn) to excellent (true baby corn. and sweet corn" in terms of responding to storage conditions, where they maintained quality well for two weeks when their baby ears stored at cold temperature (5°C), compared with storing at room temperature, which resulted in unacceptable ears after only three days of storage.

INTRODUCTION

Baby corn (*Zea mays* L.) is popular in many Asian cuisines, and has become a staple in salad bars across the United States and Europe. Baby corn is an extremely easy crop to produce from common corn plants by early harvesting while the ears are very immature, resulting in small ears or "baby corn", depending on variety .

It may be worth to mention that baby corn has high contents of folate, B-complex vitamin, C-vitamin and is good source of several nutrients. Also. baby corn would produce an attractive low-calorie vegetable, high in fiber and contains no cholesterol .

Fresh baby corn production in Egypt has several advantages over other countries, not only for suitable environmental condition, low labor costs, but also for its superior taste and texture.

Bar- Zur and Saadi (1990) and Bar – Zur and Schaffer (1993) pointed out that the optimal stage for harvesting was at silking for most cultivars and 6 days after silking for the prolific mini-corn cultivars.

Faiguenbaum and Olivares (1995) and Miles (1999) pointed out that it is recommended to harvest baby corn ears 1 to 3 days after the silks become visible. Field corn varieties may need to be harvested before the silks emerge in order to meet the size requirement, 4-9 cm long and 1-1.5 cm in diameter, for baby corn. At this early stage of ear development, ear can grow very quickly and in a day or two can easily grow larger than is acceptable . All varieties were harvested 5 to 6 times on average and yielded 2-3 ears per plant .

On average, the weight of the edible ear is about 13% of the weight of the ear with the husk. Baby corn should be stored at 5°C to 7°C , with a relative humidity of 90%.(Kotch *et al.*, 1995; Miles, 1999 and Trevor and Cantwell, 2000) Hardenburg (1971) stated that vegetables keep best under relative humidity of 90 to 95% as it minimizes wilting . Romphophak *et al.* (1993) pointed out that baby corn quality was decreased during storage in perforated plastic bags at 5°C for 0,1 or 2 weeks and stored better at 3°C than at 1°C or 5°C, but soluble solids contents decreased during storage at all temperatures. Risse and McDonald (1990) indicated that the TSS initially was 16.3%, then decreased rapidly with the increase in storage temperature and time. Evenson and Boyer (1986) pointed out that total and reducing sugar concentration of sweet corn was significantly affected by cultivar, time of storage, temperature and their interactions.

The aim of this work was to introduce a new agriculture techniques for the production of baby corn from "Field corn" and "sweet corn" cultivars, and comparing them with a true "baby corn", as well as investigating the impact of storage conditions and periods on keeping quality of baby ears of three corn hybrids.

MATERIALS AND METHODS

1. Field experiment:

Two field experiments were carried out at the Agricultural Experimental Station of the Faculty of Agriculture, Suez Canal University, Ismailia Governorate, during the two successive seasons of 1999 and 2000.

A split plot system in a randomized blocks design with four replicates was adopted, where three corn cultivars, i.e., Field corn (T.H.320), Sweet corn (Dynasty) and true baby corn (Baby Asian 6 (S.S) super), were assigned to the main plots, while harvest dates, i.e., at silking time ,one and two days after silking, were set at the sub plots. Each sub plot was 6.3 m^2 in area and consisted of 3 rows, each of 3 m long, 70 cm. width. with 25 cm. plant to plant spacing.

Seeds were sown on April 10th and July 26th of 1999 and 2000, in the two successive summer and nili plantations, respectively.

All plots were uniformly irrigated and other recommended agricultural practices for commercial maize production were followed.

Studied traits:

Ear characters: recorded at silking, one, two and three days after silking. The following parameters were recorded: Ear length (cm), ear diameter (cm), husked ear weight (gm), unhusked ear weight (gm).

Total yield and its components include Number of ears/plot, total husked and dehusked yield (Ton / Feddan), as well as husked/dehusked %

Storability study:

The three corn hybrids were harvested early in the morning and transported within two hours to the Vegetable Handling Department of the Agriculture Research Center. Leaves were completely removed and marketable baby corn ears which were (10-12 cm) in length and (1.2-1.5 cm) in diameter, were randomly packed in 250 gm. plastic trays and tightly over wrapped with stretch film (0.09 Micron thickness). Each pack was labeled weighted and placed in carton boxes. Ear packages were stored either at room temperature (24 ± 2 and 25± 2) in summer and nili seasons, respectively, or at 5^0 C and 95% relative humidity. Samples for evaluation were collected from cold room after zero, 3, 7, 10 , 14 days of storage, while at room temperature, samples were taken after zero, 3 and 7days of storage. Ear samples from both cold and room temperature storage were tested to determine the changes in physical and chemical characters as follows :

Physical characters :
Included :

- Weight loss percentage: was determined according to Ezzat *et al.* (1997).
- Appearance (visual quality): was evaluated according the following scoring scale, 9= excellent, 7= good, 5= fair, 3= poor, 1= unusable (Aharoni *et al.*, 1996).
- Texture: was estimated according the scoring scale, 1= very soft, 2= soft, 3= moderately firm, 4= firm, 5= very firm and turgid (Hardenburg, 1971).
- Decay %: was calculated in relation to the total number of stored ears (El-Seifi,1997).

Chemical characters: included total soluble solids (TSS), reducing and total sugars contents according to Forsee (1938).

Data were statistically analyzed according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

1. Baby ears characters:

Effect of cultivars

Results presented in Table (1 a,b and c) indicated significant differences among various tested corn cultivars. For instance, "Field corn" cultivar had significantly the highest mean values of ear length, ear diameter, husked and unhusked ear weight, followed by sweet corn , which in turn had significantly higher values than baby corn cultivar. These results were true for

both summer and nili seasons . Results have a similar trend to those obtained by Bar-Zur and Saadi (1990); Bar-Zur and Schaffer (1993).

Effect of harvest date

Results in Table (1 a, b and c)generally show that ear length, ear diameter, husked and unhusked ear weights increased significantly with the delay of harvest date.. Results are in line with those obtained by Galinat and Lin(1988).

Effect of the interaction

Data in Table (1c) indicated significant interactions between the tested corn cultivars and harvest dates. Results in general show that the suitable harvest date to produce baby "Field corn" ears was at silking; where marketable baby corn ears reached (8-11cm.) in length and (1.2 –1.8 cm.) in diameter. Also, the suitable harvest date for producing baby "sweet corn" was at silking and one day after silking .In spite of that , "Baby corn" cultivar produce marketable baby ears at silking , one and 2 days after silking, i.e., "Baby corn" cultivar could be harvested at all tested harvest dates. Results had a similar trend to those obtained by Galinat and Lin (1988).

These results could be attributed to the fact that the disadvantage of using normal sweet and field corn for baby corn production is the fastest development of ear shoot, so it must be picked by time of silking before it gets too big. Similar results were obtained by Faiguenbaum and Olivares, 1995; Kotch *et al*, 1995; Milles, 1999 and Thomson, 2000.

Table (1a,b and c): Effect of some corn cultivars and harvest date on baby ears characters of some corn cultivars.

a- Effect of corn cultivars

Corn cultivars	Summer season (1999)				Summer season (2000)			
	Ear characters							
	Ear length (cm.)	Ear diameter (cm)	Unhusked ear weight (gm.)	Husked ear weight (gm.)	Ear length (cm.)	Ear diameter (cm)	Unhusked ear weight (gm.)	Husked ear weight (gm.)
Field corn	13.49 a	2.00 a	93.97 a	28.34 a	13.95 a	1.95 a	92.76 a	27.55 a
Sweet corn	11.34 b	1.88 b	65.07 b	23.93 b	11.33 b	1.87 a	63.57 b	24.11 b
Baby corn	9.95 c	1.70 c	40.20 c	17.34 c	10.14 c	1.72 b	40.18 c	15.74 c
Corn cultivars	Nili season (1999)				Nili season (2000)			
	Ear characters							
	Ear length (cm.)	Ear diameter (cm)	Unhusked ear weight (gm.)	Husked ear weight (gm.)	Ear length (cm.)	Ear diameter (cm)	Unhusked ear weight (gm.)	Husked ear weight (gm.)
Field corn	13.33 a	2.03 a	104.19 a	28.14 a	14.11 a	1.99 a	108.66 a	27.10 a
Sweet corn	11.30 b	1.87 b	64.63 b	21.17 b	11.15 b	1.88 b	63.59 b	22.12 b
Baby corn	9.88 c	1.64 c	43.19 c	14.59 c	9.83 c	1 71 c	41.00 c	15.07 c

b- Effect of Harvest date

Harvest date	Summer season (1999) Ear characters								Summer season (2000) Ear characters							
	Ear length (cm.)		Ear diameter (cm)		Unhusked ear weight gm.		Husked ear weight gm		Ear length (cm)		Ear diameter cm		Unhusked ear weight gm		Husked ear weight gm	
At silking			1.53	d	39.53	d	10.33	d	9.51	d	1.52	d	37 93	d	9.77	d
One day	10.70	c	1.67	c	54.37	c	17.37	c	10.88	c	1.68	c	53.27	c	16.66	c
2 days	12.32	b	1.95	b	71.94	b	26.61	b	12.72	b	1.93	b	73.03	b	26.33	b
3 days	13.88	a	2.29	a	99.81	a	38.51	a	14.11	a	2.25	a	97.81	a	37.11	a

Harvest date	Nili season (1999) Ear characters								Nili season (2000) Ear characters							
	Ear length (cm.)		Ear diameter (cm)		Unhusked ear weight gm.		Husked ear weight (gm.)		Ear length (cm.)		Ear diameter (cm)		Unhusked ear weight (gm.)		Husked ear weight (gm.)	
At silking			1.45	d	43.92	d	9.86	d	9.28	d	1.51	d	43.75	d	10.39	d
One day	10.99	c	1.63	c	58.58	c	15.75	c	10.95	c	1.66	c	58.42	c	16.05	c
2 days	11.98	b	1.94	b	78.17	b	25.96	b	12.49	b	1.97	b	80.29	b	25.92	b
3 days	13.71	a	2.36	a	102.00	a	33.63	a	14.06	a	2.31	a	101.88	a	33.36	a

*** To be followed**

(1-C.) Interaction between corn cultivars and harvest date

Corn cultivars	Days after silking	Summer season (1999) Ears characters				Summer season (2000) Ears characters			
		Ear length (cm)	Ear diameter (cm)	Unhusked ear weight (gm.)	Husked ear weight (gm)	Ear length (cm)	Ear diameter (cm)	Unhusked ear weight (gm.)	Husked ear weight (gm)
Field corn	At silking	10.75	1.56	55.13	12.01	10.84	1.55	53.04	11.54
	One day	12.20	1.72	71.58	19.66	12.88	1.76	70.33	18.56
	2 days	14.20	2.14	99.88	31.99	14.97	2.02	101.69	31.63
	3 days	16.84	2.58	149.31	49.70	17.13	2.46	146.00	48.46
Sweet corn	At silking	9.58	1.53	39.28	9.70	9.65	1.53	37.39	9.70
	One day	10.30	1.70	55.42	18.68	10.22	1.67	53.02	18.55
	2 days	12.16	1.95	69.50	29.02	12.23	1.96	68.08	29.88
	3 days	13.32	2.34	96.08	38.33	13.21	2.34	95.81	38.31
Baby corn	At silking	8.13	1.49	24.20	9.28	8.04	1.49	23.38	8.08
	One day	9.60	1.60	36.13	13.76	9.56	1.59	36.45	12.88
	2 days	10.61	1.76	46.45	18.81	10.97	1.82	49.32	17.50
	3 days	11.48	1.95	54.04	27.50	11.98	1.96	51 58	24.53
L.S.D		0.48	0.11	6.28	1.79	0.62	0.14	11.69	2.93

Corn cultivars	Days after silking	Nili season (1999) Ears characters				Nili season (2000) Ears characters			
		Ear length (cm)	Ear diameter (cm)	Unhusked ear weight (gm.)	Husked ear weight (gm)	Ear length (cm)	Ear diameter (cm)	Unhusked ear weight (gm.)	Husked ear weight (gm)
Field corn	At silking	10.75	1.54	64.00	11.63	10.90	1.56	62.13	11 68
	One day	12.75	1.75	79.00	18.00	12.74	1.71	78.75	18.10
	2 days	13.62	2.20	113 50	33.28	15.33	2.13	121.75	33.61
	3 days	16.22	2.63	160.25	49.65	17.43	2.55	172.00	45.00
Sweet corn	At silking	9.53	1.46	38.25	10.33	9.33	1.54	41.38	10.50
	One day	10.70	1.62	56.25	17.48	10.33	1.67	58.75	18.55
	2 days	11.83	1.97	75.75	27.23	11.69	2.00	73.13	27.15
	3 days	13.15	2.43	88.25	29.65	13.28	2.30	81.13	32 28
Baby corn	At silking	7.75	1.34	29.50	7.63	7.61	1.41	27.75	9.00
	One day	9.53	1.53	40.50	11.78	9.80	1.59	37.75	11.49
	2 days	10.51	1.67	45.25	17.38	10.45	1.79	46.00	16.99
	3 days	11.73	2.20	57.50	21.60	11.48	2.07	52.50	22.81
L.S.D		0.65	0.09	6.19	2.76	0.53	0.19	13.46	3.19

2.Total yield and its components :

Effect of cultivars :

Results in Table (2 a,b and c) generally indicate that true Baby corn cultivar produced significantly the highest number of baby ears/plot, followed by Sweet corn cultivar which subsequently was significantly higher than Field corn cultivar. Such results could be attributed to inherited cultivar s characters The obtained results were supported with those obtained by Bar-Zur and Saadi (1990).

Results show that "Field corn" cultivar produced significantly the highest unhusked yield, followed by "Sweet corn" cultivar, while "Baby corn" cultivar was the lowest .The superiority of the "Field corn" cultivar may be due to its seed vigorously and to high dry matter accumulation which in turn increased total unhusked baby ears yield. In fact, the increase in unhusked ear weight may be due to the increase in number of leaves/plant and flag leaf area, which in turn may lead to higher translocation of assimilates from source (flag leaf) to sink (ear) and consequently resulted in higher husked baby ear yield .The obtained results agreed with those reported by Mason and Zuber(1976).

"Sweet corn" cultivar produced significantly the highest husked yield, followed by "Field corn", and the highest husked /unhusked ratio , followed by "Baby corn" cultivar during the summer season. In nili season , again, "Sweet corn" was significantly the best in terms of both total husked yield and husked/unhusked ratio, followed by "Baby corn" and then "Field corn" cultivar came at last . The obtained results are in agreement with those obtained by Bar-Zur and Saadi (1990) and Thomson (2000).

Effect of harvest date :

Data in Table (2 a,b and c)generally indicate that harvesting "Baby corn" ears at silking significantly produced the highest number of ears/plot ,followed by one day after silking which was higher than 2 days. In fact two days after silking significantly produced the lowest number of ears/plot, and that was true for both summer and nili seasons. Results had similar trend with those obtained by Bar-Zur and Saadi (1990) and Thomson (2000).

With respect to total husked, unhusked yield and total husked / unhusked ratio, the obtained results, generally, show significant differences among tested harvest dates. Harvest at one day after silking significantly produced the highest unhusked ears yield, followed by 2 days after silking, while harvesting at silking produced the lowest unhusked yield, and that was true for both summer and nili seasons.

Regarding the husked yield and husked/unhusked ratio, obtained results show that harvest at 2 days after silking significantly produced the highest husked yield and husked/unhusked ratio, followed by one day after silking, while harvest at silking produced significantly the lowest husked yield and husked/unhusked ratio, except that there was no significant difference between the harvesting time at one day or two days after silking on total husked yield in nili seasons. Results are in line with those obtained by Bar-Zur and Saadi(1990), Milles (1999) and Thomson (2000).

Table (2 a,b and c): Effect of some corn cultivars and harvest date on total yield and its components. ton/fed.

a- Effect of corn cultivars

Corn cultivars	Summer season (1999)				Summer season (2000)			
	Total yield and its components							
	No. of ears / plot	Total unhusked yield ton./fed	Total husked yield ton /fed	Total husked /unhusked (%)	No. of ears/ plot	Total unhusked yield ton./fed	Total husked yield ton /fed	Total husked /unhusked %
Field corn	63.75 c	2.839 a	0.923 b	32.40 c	59.83 c	2.799 a	0.896 b	31.89 b
Sweet corn	71.08 b	2.425 b	0.983 a	40.46 a	70.08 b	2.417 b	0.960 a	39.69 a
Baby corn	106.08 a	2.301 c	0.883 c	38.41 b	103.50 a	2.288 c	0.886 b	38.71 a

Corn cultivars	Nili season (1999)				Nili season (2000)			
	Total yield and its components							
	No. of ears/ plot	Total unhusked yield ton./fed	Total husked yield ton /fed	Total husked /unhusked (%)	No. of ears/ plot	Total unhusked yield ton./fed	Total husked yield ton /fed	Total husked /unhusked %
Field corn	60.17 c	3.080 a	0.840 b	27.11 b	57.67 c	3.059 a	0.816 b	26.39 c
Sweet corn	69.25 b	2.415 b	0.907 a	37.45 a	68.08 b	2.640 b	0.872 a	33.59 b
Baby corn	103.92 a	2.382 b	0.869 b	36.54 a	103.25 a	2.245 c	0.872 a	38.74 a

b- Effect of Harvest date

Harvest date	Summer season (1999)				Summer season (2000)			
	Total yield and its components							
	No. of ears/ plot	Total unhusked yield ton./fed	Total husked yield ton /fed	Total husked /unhusked (%)	No. of ears/ plot	Total unhusked yield ton./fed	Total husked yield ton /fed	Total husked /unhusked %
At silking	94.08 a	2.341 c	0.789 c	33.91 c	91.58 a	2.328 c	0.779 c	33.77 c
One day	79.92 b	2.716 a	0.981 b	36.28 b	77.83 b	2.677 a	0.959 b	35.96 b
2 days	66.92 c	2.508 b	1.018 a	41.09 a	64.00 c	2.501 b	1.004 a	40.56 a

Harvest date	Nili season (1999)				Nili season (2000)			
	No. of ears/ plot	Total unhusked yield ton./fed	Total husked yield ton /fed	Total husked /unhusked (%)	No. of ears/ plot	Total unhusked yield ton./fed	Total husked yield ton /fed	Total husked /unhusked %
At silking	92.75 a	2.472 b	0.708 b	29.23 c	90.17 a	2.645 b	0.681 b	26.42 c
One day	77.42 b	2.897 a	0.957 a	33.46 b	76.25 b	2.802 a	0.944 a	34.44 b
2 days	63.17 c	2.506 b	0.950 a	38.42 a	62.58 c	2.497 c	0.934 a	37.87 a

*To be followed

(2-C)- interaction between corn cutivars and harvest date

Total yield and its components	Harvest date	Summer season (1999)				Summer season (2000)			
		Corn cultivars			L.S.D	Corn cultivars			L.S.D
		Field corn	Sweet corn	Baby corn		Field corn	Sweet corn	Baby corn	
No. of ears /plot	At silking	73.00	83.50	125.75	3.98	68.25	82.00	124.50	4.42
	One day after silking	66.25	69.50	104.00		64.00	68.25	101.25	
	Two days after silking	52.00	60.25	88.50		47.25	60.00	84.75	
Total unhusked yield ton /Fed.	At silking	2.574	2.179	2.269	0.090	2.547	2.183	2.253	0.090
	One day after silking	3.137	2.659	2.353		3.094	2.619	2.317	
	Two days after silking	2.806	2.439	2.280		2.757	2.450	2.295	
Total husked yield ton /Fed.	At silking	0.784	0.801	0.782	0.048	0.741	0.811	0.787	0.050
	One day after silking	1.056	1.034	0.854		1.050	0.986	0.840	
	Two days after silking	0.928	1.113	1.014		0.898	1.082	1.031	
Total husked / unhusked %	At silking	30.45	36.81	34.45	3.10	29.16	37.23	34.92	2.41
	One day after silking	33.68	38.88	36.28		33.94	37.66	36.28	
	Two days after silking	33.08	45.69	44.51		32.58	44.18	44.92	

(2-C)- interaction between corn cutivars and harvest date

Total yield and its components	Harvest date	Nili season (1999)				Nili season (2000)			
		Corn cultivars				Corn cultivars			
		Field corn	Sweet corn	Baby corn	L.S.D	Field corn	Sweet corn	Baby corn	L.S.D
No. of ears /plot	At silking	69.25	80.75	128.25	4.33	66.50	77.50	126.50	5.34
	One day after silking	65.00	68.50	98.75		62.75	68.00	98.00	
	Two days after silking	46.25	58.50	84.75		43.75	58.75	85.25	
Total unhusked yield ton /Fed.	At silking	2.886	2.237	2.294	0.083	2.801	2.902	2.231	0.039
	One day after silking	3.575	2.606	2.511		3.631	2.611	2.164	
	Two days after silking	2.778	2.400	2.340		2.744	2.407	2.340	
Total husked yield ton /Fed.	At silking	0.646	0.734	0.745	0.055	0.575	0.687	0.782	0.051
	One day after silking	1.058	0.979	0.834		1.084	0.923	0.825	
	Two days after silking	0.815	1.008	1.028		0.790	1.005	1.008	
Total husked / unhusked %	At silking	22.37	32.82	32.51	2.25	20.53	23.68	35.06	1.61
	One day after silking	29.61	37.55	33.21		29.86	35.36	38.10	
	Two days after silking	29.35	41.98	43.93		28.78	41.76	43.07	

Effect of the Interaction:

Results presented in Table (2-c) show a significant effect for the interaction between harvest date and corn cultivars on number of ears/ plot, total unhusked, husked yield and husked/unhusked percent . In fact, true "Baby corn" cultivar was significantly the highest in increasing number of ears/plot at all tested harvest dates, followed by "Sweet corn", while "Field corn" produced the lowest number of ears/plot. The interaction proved that highest No.of ears/plot were produced from "Baby corn" at silking. The interaction also showed that delaying harvest time, regardless the cultivar, resulted in a reduction in number of ear/ plot. The obtained results were true for both summer and nili seasons. Similar results were obtained obtained by Bar-Zur and Schaffer (1993).

Also, data in Table (2-c) show that Field corn cultivar produced the highest unhusked and husked yield, specially at one day after silking followed by "Sweet corn" and "Baby corn" cultivars. However,"Sweet corn" cultivar produced the highest husked yield when harvested at silking and two days after silking followed by "Baby corn" cultivar without significant differences, especially in summer season. Results had a similar trend to the results previously reported by Bar-Zur and Saadi(1990) and Milles(1999)

In general, "Sweet corn" cultivar produced the highest ratio husked/unhusked followed by Baby corn cultivar, without significant differences sometimes, while Field corn cultivar led to the lowest ratio during the tested harvest dates .These results held true for both summer and nili seasons .

3.Storability study:

Effect of corn cultivars :

Obtained data in Tables (3) and (4) show that "Field corn" cultivar was significantly the highest in weight loss percentage, followed by "Sweet corn", which in turn was higher than "Baby corn" cultivar.The obtained results were true in both summer and nili seasons, especially under cold storage condition, while "Baby Sweet corn" ears were significantly the lowest in weight loss percentage under room temperature condition, followed by both Baby and Field corn cultivars without significant difference. Such variations among studied cultivars may be due to their genetic makeup which are considered the main factors in these respects. These results are in harmony with those obtained by Hardenburg (1971) and Deak et al. (1987).

The obtained data also indicate that there were no significant differences between the tested corn cultivars in appearance, texture and decay percentage, under cold storage and room temperature conditions and that was also true for both summer and nili seasons.

Results illustrate that baby ears produced from "Field corn" cultivar had significantly higher TSS than the other tested cultivars in both two summer and nili seasons, under room temperature only,but not always significant in second summer season under cold storage .Whereas, the highest TSS was scored by "Baby corn" cultivar in the first season of summer plantation under cold storage .However ,the lowest TSS value was recorded in baby Sweet ear.

Table (3) : Effect of some corn cultivars and storage periods on storageability of baby corn ears under cold and room temperature during summer seasons 1999 and 2000.

* Cold storage 5C

Corn cultivars	Summer season 1999														Summer season 2000											
	Loss in weight %		Appearance		T.S.S		Texture		Decay %		Reducing sugars		Total sugars		Loss in weight %		Appearance		T.S.S		Texture		Decay %		Reducing sugars		Total sugars	
a - Effect of cultivars																										
Field corn	3.95	a	8.13	a	9.39	b	1.81	a	7.75	a	9.25	b	17.18	b	3.57	a	8.38	a	9.36	a	1.69	a	7.81	a	9.32	ab	17.31	b
Sweet corn	3.01	b	8.25	a	9.05	c	1.75	a	8.16	a	9.44	a	17.63	a	3.16	b	8.50	a	8.67	b	1.63	a	9.31	a	9.52	a	17.66	a
Baby corn	2.37	c	7.88	a	10.18	a	1.69	a	8.00	a	9.25	b	17.15	b	2.54	c	8.50	a	9.53	a	1.75	a	7.56	a	9.27	b	17.26	c
b – Effect of storage period.																										
Zero day	0.00	e	9.00	a	9.68	b	1.00	c	0.00	c	10.02	a	17.95	a	0.00	e	9.00	a	9.61	b	1.00	c	0.00	c	10.17	a	18.17	a
3 days	1.44	d	9.00	a	8.92	d	1.00	c	0.00	c	9.74	c	17.48	c	1.44	d	9.00	a	8.73	c	1.00	c	0.00	c	9.76	b	17.54	c
7 days	2.44	c	8.33	ab	9.38	c	1.25	c	0.00	c	8.45	e	16.68	d	2.62	c	9.00	a	8.83	c	1.33	c	0.00	c	8.48	c	16.69	d
10 days	3.65	b	8.17	b	9.09	d	2.17	b	7.25	b	8.55	d	16.72	d	3.54	b	8.50	a	8.28	d	1.83	b	6.25	b	8.59	c	16.79	d
14 days	4.91	a	6.83	c	10.63	a	2.58	a	24.63	a	9.81	b	17.77	b	4.76	a	7.33	b	10.46	a	2.58	a	26.67	a	9.85	b	17.87	b
Room temperature																										
A – Effect of cultivars																										
Field corn	13.43	a	4.50	a	10.48	a	3.13	a	25.13	a	9.30	b	17.17	b	13.49	a	5.25	a	10.72	a	3.75	a	29.38	a	9.41	a	17.43	b
Sweet corn	12.62	b	4.50	a	10.01	b	3.13	a	24.38	a	9.57	a	17.70	a	12.39	b	4.50	a	9.38	c	3.38	a	32.25	a	9.66	a	17.72	a
Baby corn	12.76	ab	4.50	a	9.74	b	3.62	a	24.50	a	9.29	b	17.18	b	13.14	a	4.75	a	10.05	b	3.38	a	31.63	a	9.32	a	17.31	b
b – Effect of storage period.																										
zero day	0.00	c	9.00	a	9.99	b	1.00	c	0.00	c	10.02	a	17.95	a	0.00	c	9.00	a	9.61	b	1.00	c	0.00	c	10.17	a	18.17	a
3 days	10.45	b	5.33	b	10.35	a	2.83	b	19.25	b	8.29	c	16.38	c	9.81	b	5.67	b	9.77	b	3.00	b	21.33	b	8.33	c	16.53	c
7 days	15.43	a	3.66	c	9.89	b	3.75	a	30.08	a	9.86	b	17.72	b	16.20	a	4.00	c	10.77	a	4.00	a	40.83	a	9.89	b	17.76	b

Table (4): Effect of some corn cultivars and storoge period on storageability of baby ears under cold storage and room temperature during nili seasons 1999 - 2000.

Corn cultivars	Nili season 1999												Nili season 2000											
	Loss in weight %		Appear-ance		T.S.S		Texture		Decay %		Reducing sugars		Total sugars		Loss in weight %		Appear-ance		T.S.S		Texture		Decay %		Reducing sugars		Total sugars	
*** Cold storage 5 °C**																												
a - Effect of cultivars																												
Field corn	3.36	a	7.25	a	10.00	a	2.06	a	7.50	a	9.41	b	17.33	b	3.52	a	7.25	a	8.94	a	1.69	a	8.38	a	9.33	b	17.41	b
Sweet corn	3.20	a	7.63	a	9.53	b	2.06	a	8.63	a	9.64	a	17.59	a	3.07	b	7.50	a	8.36	b	1.69	a	9.75	a	9.51	a	17.70	a
Baby corn	2.68	b	7.38	a	10.25	a	1.88	a	9.25	a	9.32	b	17.22	b	2.37	c	7.38	a	8.44	b	1.56	a	8.19	a	9.36	b	17.30	b
b – Effect of storage period.																												
zero day	0.00	e	9.00	a	9.99	b	1.00	d	0.00	c	10.52	a	17.98	a	0.00	E	9.00	a	9.72	a	1.00	c	0.00	c	10.03	a	18.32	a
3 days	1.58	d	9.00	a	9.34	c	1.00	d	0.00	c	9.79	b	17.56	b	1.53	D	9.00	a	8.13	c	1.00	c	0.00	c	9.81	b	17.60	c
7 days	2.47	c	8.00	b	9.43	c	1.50	e	0.00	c	8.51	c	16.73	c	2.64	C	8.33	b	7.83	d	1.00	c	0.00	c	8.53	d	16.75	d
10 days	3.56	b	7.00	e	9.98	b	2.50	b	7.08	b	8.60	c	16.74	c	3.50	B	6.50	c	7.79	d	1.92	b	7.67	b	8.69	c	16.74	d
14 days	4.71	a	5.67	d	10.90	a	3.00	a	26.75	a	9.87	b	17.91	a	4.27	A	5.67	d	9.44	b	2.67	a	27.42	a	9.92	ab	17.95	b
*** Room temperature**																												
a – Effect of cultivars																												
Field corn	11.89	a	4.75	a	10.48	a	3.50	a	31.88	a	9.55	b	17.35	a	12.17	A	5.75	a	10.60	a	3.38	a	30.13	a	9.35	b	17.45	ab
Sweet corn	11.33	b	4.50	a	10.01	b	3.38	a	31.25	a	9.84	a	17.59	a	10.89	B	5.25	a	9.62	b	3.38	a	33.63	a	9.59	a	17.74	a
Baby corn	12.20	a	5.25	a	9.74	b	3.50	a	30.00	a	9.41	b	17.23	a	11.28	Ab	6.00	a	9.47	b	3.00	a	32.50	a	9.42	b	17.33	ab
b – Effect of storage period.																												
zero day	0.00	c	9.00	a	9.99	b	1.00	c	0.00	c	10.52	a	17.98	a	0.00	c	9.00	a	9.73	b	1.00	c	0.00	c	10.03	a	18.32	a
3 days	8.70	b	5.50	b	10.35	a	2.83	b	22.92	b	8.36	c	16.45	c	8.36	b	6.50	b	10.08	a	2.58	b	22.92	b	8.39	b	16.48	c
7 days	14.91	a	4.17	b	9.89	b	4.08	a	39.17	a	9.92	b	17.75	b	14.53	a	4.83	c	9.88	ab	3.92	a	41.25	a	9.94	a	17.71	b

Data in Table (3 and 4) clearly indicate that baby ears produced from "Sweet corn" cultivar had significantly the highest contents of reducing and total sugars, followed by "Field and Baby corn" cultivars which showed no significant difference among each other. These results were true under both storage conditions, cold and room temperature, as well as in both summer and nili seasons .

Effect of storage period:

Data recorded in Tables (3and 4) show significant differences in keeping quality of studied characters of "Baby corn" ears under both storage conditions, i.e., cold and room temperature with the prolongation of storage period. The fresh weight of Baby ears decreased considerably and consistently during storage periods, i.e., 14 and 7 days under cold and room temperature, respectively. Moreover, the variation in weight loss was relatively higher under room temperature than cold storage. These results may be due to the higher rate of respiration and other biochemical changes occurring after harvesting which lead to senescence, especially at high temperature such as room conditions. Also, the loss in fresh weight equals the amount of water loss through transpiration, plus the amount of loss in dry matter through respiration. Obtained results are in harmony with those of Wann *et al.* (1971).

Obtained results also reveal significant differences in tested storage characters during storage period. The differences in appearance values of baby ears during storage were significantly minimized after ten and three days from storage under cold and room conditions, respectively, in both summer and nili seasons. On the contrary, the decay percentage and texture mean values gradually increased with the progress of storage period. Furthermore, the decay of ears started to occur after ten and three days in cold and room temperatures, respectively. This may be due to the continuous chemical and biochemical changes that took place in the baby corn ears which led to moisture condensation and transformation of complex compounds to simple forms of more liability to fungus infection such as the change from the solid protopectin to the soluble pectin form . These data were confirmed by other investigators such as Ben-Yehoshua, (1985); Risse and McDonald, (1990) and Romphophac *et al*,(1993).

Regarding the total soluble solids content, data show a gradual decrease until ten days in cold storage and three days in room temperatures, then increased till the end of storage period, in both summer and nili seasons. This may be explained by the degradation of complex insoluble compounds to simple molecules through the period of storage, and that was true for both summer and nili seasons . The obtained results are in agreement with those obtained by Kotch *et al* (1995) and Milles (1999)

With respect to reducing and total sugars, results in table (3 and 4) indicate that reducing and total sugars content in baby ears decreased slowly and gradually to reach minimum values after ten days under cold storage condition, whereas it decreased rapidly after three days under room temperature condition. Additionally, it can be concluded from the same data that reducing and total sugars increased at the end of storage period, i.e.14 and 7days from storage and that was true for both summer and nili seasons.

Such outcomes may be due to the hydrolysis of other forms of carbohydrates to a simple form as of glucose and fructose and may be due, as well, to the complex inversion of sucrose (non-reducing sugar)to reducing sugars probably by invertase during storage period. Similar conclusions were obtained by Evensen and Boyer(1986) and Kotch *et al*(1995).

Effect of the interaction:

Data in Tables (5a and b) and (6 a and b) show that visual quality and chemical characters declined gradually with time during storage especially at room conditions.

Overall, from the aforementioned results, it could be suggested that each cultivar showed a different degree of dependence. All cultivars under study could be ranked as very good (Field corn cultivar) to excellent (true Baby corn followed by Sweet corn cultivar), where they maintained quality well for 2 weeks when their baby ears stored at cold temperature (5°C) than at room temperature, which was unacceptable after only three days at normal conditions. These differences in storability of baby ears may be attributed to the differences in the genetical nature of the three tested corn cultivars.

Table (5): Interaction between corn cultivars and storage period.

(A) * cold storage (^{0}C)

Quality features	Storage period in days	Nili season (1999)			L.S.D	Nili season (2000)			L.S.D
		Field corn	Sweet corn	Baby corn		Field corn	Sweet corn	Baby corn	
Loss in weight %	3	1.99	1.35	0.98	0.48	1.76	1.40	1.16	0.53
	7	3.41	2.39	1.51		2.99	2.87	1.98	
	10	4.55	3.67	2.73		4.19	3.69	2.74	
	14	5.84	4.64	4.25		5.33	4.66	4.29	
Appearance	zero	9.00	9.00	9.00	1.15	9.00	9.00	9.00	0.93
	3	9.00	9.00	9.00		9.00	9.00	9.00	
	7	8.50	8.50	8.00		9.00	9.00	9.00	
	10	8.50	8.50	8.00		8.50	8.50	8.50	
	14	6.50	7.00	7.00		7.00	7.50	7.50	
T S S	zero	10.04	9.18	9.82	0.48	10.26	9.18	9.40	0.45
	3	9.45	8.30	9.00		9.40	7.95	8.85	
	7	8.95	8.70	10.50		8.85	7.85	9.80	
	10	7.45	9.25	10.58		7.55	8.65	8.65	
	14	11.08	9.80	11.00		10.73	9.70	10.95	
Texture	zero	1.00	1.00	1.00	0.59	1.00	1.00	1.00	0.62
	3	1.00	1.00	1.00		1.00	1.00	1.00	
	7	1.25	1.50	1.00		1.25	1.25	1.50	
	10	2.25	2.00	2.25		2.00	1.75	1.75	
	14	2.75	2.50	2.50		2.50	2.50	2.75	
Decay %	zero	0.00	0.00	0.00	1.79	0.00	0.00	0.00	3.97
	3	0.00	0.00	0.00		0.00	0.00	0.00	
	7	0.00	0.00	0.00		0.00	0.00	0.00	
	10	9.13	6.38	6.25		6.25	7.25	5.25	
	14	21.88	26.25	25.75		25.00	30.00	25.00	
Reducing sugars	zero	9.89	10.27	9.91	0.09	10.12	10.48	9.92	0.22
	3	9.64	9.82	9.77		9.65	9.86	9.78	
	7	8.43	8.54	8.37		8.50	8.57	8.39	
	10	8.53	8.69	8.45		8.56	8.76	8.40	
	14	9.76	9.91	9.77		9.78	9.96	9.80	
Total sugars	zero	17.75	18.53	17.58	0.20	18.17	18.44	17.89	0.24
	3	17.37	17.83	17.25		17.46	17.85	17.31	
	7	16.63	16.77	16.64		16.66	16.77	16.65	
	10	16.65	16.92	16.60		16.71	17.00	16.65	
	14	17.52	18.12	17.69		17.57	18.26	17.79	

Table (5) : Interaction between corn cultivars and storage period.
(B)* Room temperature

Quality		Summer season (1999)				Summer season (2000)			
		Field corn	Sweet corn	baby corn	L.S.D	Field corn	Sweet corn	baby corn	L.S.D
Loss in weight %	3	10.79	9.46	11.09	1.23	10 05	8.34	11.04	0 95
	7	16.06	15.79	14.44		16 94	16.43	15.24	
Appearance	zero	9.00	9.00	9.00	1 40	9 00	9 00	9 00	1.25
	3	5.50	5.00	5.50		6.50	5 00	5.50	
	7	3.50	4.00	3.50		3.75	4.00	5.00	
T S S	zero	10.04	9 18	9.62	0 32	10.26	9 18	9.40	0.44
	3	11.05	8.85	9.00		11.00	9 30	9.00	
	7	11.00	9.70	11 65		10.90	9 65	11.75	
texture	zero	1 00	1 00	1 00	0.73	1 00	1 00	1 00	0 72
	3	2.75	2.50	3.25		3.25	3.00	2 75	
	7	3.50	3 75	4.00		4.00	3.75	4 00	
Decay %	zero	0.00	0.00	0 00	2 82	0 00	0.00	0.00	5.29
	3	21.25	18 75	17.75		22.50	22.00	19.50	
	7	29.00	30.00	31.25		36.25	42 50	43 75	
Reducing sugars	zero	9.89	10 27	9.91	0.17	10 12	10.48	9 92	0 30
	3	8 23	8 39	8.24		8 32	8 41	8.27	
	7	9.79	10.06	9 73		9 79	10.11	9.77	
Total sugars	zero	17.75	18.53	17 58	0.37	18 17	18.44	17.89	0.24
	3	16.24	16.62	16.28		16 50	16.67	16.44	
	7	17 52	17.96	17 68		17.61	18.05	17 61	

Table (6) : Interaction between corn cultivars and storage period.
(A)* cold storage (^{0}C)

Quality features	Storage period in days	Nili season (1999)			L.S.D	Nili season (2000)			L.S.D
		Field corn	Sweet corn	Baby corn		Field corn	Sweet corn	Baby corn	
Loss in weight %	3	1 81	1 69	1 23	0 57	1.69	1 72	1 19	0 46
	7	2.81	2.74	1.86		3 42	2.57	1 92	
	10	4 10	3.76	2.82		4.24	3.52	2.76	
	14	4 71	4.62	4.82		4.74	4.48	3 59	
Appear-ance	zero	9.00	9.00	9.00	1.27	9.00	9.00	9 00	0 63
	3	9.00	9.00	9.00		9.00	9.00	9.00	
	7	8.00	8.00	8.00		8.50	8 50	8.00	
	10	6.50	7.50	7 00		6 00	7 00	6.50	
	14	5.50	6.00	5.50		5.50	5.50	6.00	
T S S	zero	10.46	9.06	9.83	0 52	10 56	9.00	9.61	0 43
	3	10.02	8.55	9.45		9.30	7 43	7 65	
	7	9.58	8.65	10.05		8.25	7 18	8.05	
	10	8 78	10.28	10.90		7 05	7 76	8.55	
	14	11 18	10.53	11 00		9.55	10.43	8.34	
Texture	zero	1.00	1.00	1 00	0 53	1 00	1 00	1 00	0 49
	3	1 00	1 00	1 00		1 00	1 00	1 00	
	7	1 50	1 75	1 25		1 00	1 00	1 00	
	10	2.50	2.50	2.50		2.00	1 75	1 75	
	14	3.25	3.00	2.75		2 50	2.25	2.50	
Decay %	zero	0.00	0.00	0.00	4.59	0.00	0 00	0.00	3 31
	3	0.00	0 00	0.00		0.00	0.00	0.00	
	7	0.00	0.00	0.00		0 00	0.00	0.00	
	10	6 25	6 75	8.25		7.75	7 50	7 75	
	14	23 75	27 75	28 75		25 75	31 50	25.00	
Reducing sugars	zero	10.49	10 94	10 14	0.23	9 86	10 15	10.09	0 20
	3	9 67	9.91	9 79		9 71	9.93	9 81	
	7	8.53	8.58	8.43		8.57	8.61	8.43	
	10	8.60	8.81	8.40		8.62	8.87	8.59	
	14	9.78	9.99	9.65		9.89	10.02	9.87	
Total sugars	zero	18.09	18 13	17 71	0 30	18.38	18.63	17 95	0.23
	3	17 46	17 88	17 33		17 52	17.88	17 41	
	7	16.69	16.78	16 71		16 71	16.80	16 74	
	10	16.81	16.90	16.52		16.83	16.86	16.56	
	14	17 61	18 28	17.84		17 63	18.34	17 88	

Table (6) : Interaction between corn cultivars and storage period.
(B)* Room temperature

Quality features	Storage period in days	Nili season (1999)			L.S.D	Nili season (2000)			L.S.D
		Field corn	Sweet corn	Baby corn		Field corn	Sweet corn	Baby corn	
Loss in weight %	3	9.89	6.96	9.26	1.33	9.90	6.99	8.19	1.16
	7	13.88	15.69	15.14		14.44	14.79	14.37	
Appearance	zero	9.00	9.00	9.00	1.29	9.00	9.00	9.00	0.93
	3	6.00	5.00	5.50		7.00	7.00	7.50	
	7	3.75	4.00	5.00		5.00	6.00	5.00	
T S S	zero	10.46	9.06	9.83	0.32	10.56	9.00	9.61	0.53
	3	11.00	10.55	9.50		11.00	10.35	8.90	
	7	9.98	9.83	9.88		10.25	9.50	9.90	
Texture	zero	1.00	1.00	1.00	0.53	1.00	1.00	1.00	0.78
	3	2.75	2.75	3.00		2.75	2.25	2.75	
	7	4.25	4.00	4.00		4.00	3.75	4.00	
Decay %	zero	0.00	0.00	0.00	8.71	0.00	0.00	0.00	4.57
	3	26.25	20.00	22.50		24.25	36.00	23.50	
	7	37.50	42.50	37.50		21.00	43.75	44.00	
Reducing sugars	zero	10.49	10.94	10.14	0.32	9.86	10.15	10.09	0.26
	3	8.35	8.44	8.29		8.36	8.49	8.32	
	7	9.81	10.16	9.79		9.83	10.13	9.86	
Total sugars	zero	18.09	18.13	17.71	0.39	18.38	18.63	17.95	0.34
	3	16.43	16.62	16.30		16.43	16.64	16.38	
	7	17.53	18.01	17.70		17.54	17.94	17.66	

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دراسات على المحصول والقدرة التخزينية لكيزان الذرة الصغيرة

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أجريت هذه الدراسة بمزرعة كلية الزراعة – جامعة قناة السويس بالإسماعيلية خلال الموسمين الصيفى والنيلى للعامين المتتاليين ١٩٩٩ ، ٢٠٠٠م كما أجريت تجربة التخزين فى معمل تداول وتخزين الخضر بمعهد بحوث البساتين بالجيزة وذلك لدراسة محصول الكيزان الصغيرة ومواصفاته والقدرة التخزينية لتلك الكيزان لثلاث سلالات هى: الذرة الحقلية والذرة السكرية والذرة الصغيرة الحقيقية.

أنتجت سلالة الذرة الحقلية أكبر طول وقطر كوز تليها سلالة الذرة السكرية وكان أنسب موعد لحصاد الكيزان بالمواصفات التسويقية المطلوبة (٨-١١ سم طول) و (١,٣ – ١,٨ سم قطر) من الذرة الحقلية يوم ظهور الحريرة بينما كان فى الذرة السكرية عند ظهور الحريرة وبعد يوم واحد من ظهورها فى حين أن سلالة الذرة الحقيقية فإنه يمكن الحصول على الكيزان المطابقة للمواصفات من يوم ظهور الحريرة وحتى ٣ أيام بعدها بالإضافة إلى إنتاجها لأكبر عدد من الكيزان تليها الذرة السكرية ثم الذرة الحقلية أخيرا. كما أعطت السلالة الحقيقية أعلى محصول كيزان قابل للتسويق سواء بالأغلفة أو دون اغلفة.

تفوقت الكيزان المنتجة من سلالة الذرة الصغيرة فى القدرة التخزينية حيث كانت أقل فقدا فى الوزن تليها كيزان السلالة السكرية ثم كيزان سلالة الذرة الحقيقية ولم تكن هناك فروق معنوية بين الثلاث سلالات فى صفات الشكل الظاهرى والنسبة المئوية للتلف تحت ظروف التخزين المبرد وعلى درجة حرارة الغرفة، كما تناقصت صفات الجودة مع التغيرات الكيماوية بطول فترة التخزين حتى أسبوعين على درجة حرارة ٥ مئوى وحتى ثلاث أيام على درجة حرارة الغرفة.