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A comparative study on storability of some onion (*Allium cepa* L.) bulbs produced under different fertilizers

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This study was carried out during the period from July to October of 2015/16 and 2016/17 at onion store of Horticultural Crops Research Center at Shambat, Agricultural Research Corporation, Sudan, Khartoum North, to investigate the performance of bulbs of five onion cultivars; Baftaim (S) (red), Saggai lmproved (red), Abu-Freaiwa (dark red), Kamleen (yellow), Texas Early Yellow Grano (yellow) produced at different fertilizers; urea, organic, NPK, ammonium sulphate and control (without fertilizers) to storability. The treatments were arranged in a completely randomized design (CRD) with three replications. The data collected include percentages of total loss, rotted, sprouted and infected bulbs with black mold. The results indicated that the cultivar Texas Early Yellow Grano contained the highest rotting, sprouting, infected bulbs by black mold and total weight loss, while cultivar Baftaim (S) gave the lowest percentage of rotting, infected bulbs by black mold and total loss in the beginning of storage period and the lowest percentage of sprouting during the storage period.

Local onion cultivars store better than Texas Early Yellow Grano.

Keywords: Onion, fertilizers, cultivars, storability.

I. Introduction

Onion is a seasonal crop, it is grown in the cool dry season and has comparatively low storability and bulbs are usually stored until the harvest of next season crop for longer period due to seasonal glut in the market [1].

Onion bulbs storage is essential to the onion industry for so as, to be available all around the year, being a biennial crop, therefore, bulbs for seed production must be stored until the following growing season.

The benefit of the storage is to extend the period of availability of crop, maintain optimum bulb quality and minimize losses from physical, physiological, and pathological agents [2].

Storability of onion bulbs poses great problems due to pre and post-harvest conditions. Interaction of many factors contribute to quality of bulbs in post-harvest and for successful storage; these include cultivars, agronomic practices like mineral nutrition, , field curing, handling of bulbs and storage environment. ([3], [4], [5], [6], [7] and [8]).

Storage is a serious problem in tropical countries, significant losses in quantity and quality of onion occur during storage [1], due to lack of the proper stores, onions are stored by farmers with traditional technique in shelters under ambient conditions, [9], and this traditional storage system results in increased postharvest losses of onion.

[10] Reported that sprouting caused shriveling of bulbs, consequently lowering marketable quality. Higher respiration rate with heat generation enhances re-growth of onion during storage causing moisture loss from bulb and reduces shelf life [9], whereas [11] indicated that maximum bulb sprouting losses were noticed at lower temperatures and high humidity during August to November. [12] Found that there was a progressive increase in sprouting of onion bulbs with advancement of storage duration increasing from 1.6% at 6 weeks after storage to 14.1 % at 12 weeks of storage.

Postharvest losses reach 40% of total production due to sprouting, decay, and rooting and weight loss [13]. Storage losses reached 43.9% of onion with different storage methods without curing of the bulbs and 31.9% even after curing over the storage period of 4 months [14]. Also [15], found that the losses, where no bottom ventilation is provided, are estimated to the extent of 30 to 35 percent, 10 to 12 percent by rotting and 8 to 12 percent on an account of sprouting, depending upon the relative humidity and temperature during the rainy season. In the Sudan, harvest and post-harvest losses can reach up to 40-60% [16].

Onion storage is important to provide product for fresh market, export, and processing and price stability. Storage potential of onion mainly depends on the cultivar and cultural practices, climate conditions during growing season and storage method ([17] and [18]). The present study was initiated with the following objective:

To reduce the effects of some detritions' pre and post harvesting factors that causes the losses of onion bulbs during storage to extend onion bulbs shelf life, the present is study was conducted.

II. MATERIALS AND METHODS

The storage experiments were carried out from July to November of 2015 /16 and 2016/17 at onion store of Horticultural Crops Research Center at Shambat Research Station , Agricultural Research Corporation , Sudan , Khartoum North (Lat. 15° 40" N and long . 32° 32"E . and 281m. above sea level).

The treatments were five onion cultivars and five types of fertilizers:

The onion cultivars were:

1- Baftaim (S) (red).
2- Saggai lmproved (red),
3- Abu-Freaiwa (dark red).
4- Kamleen (yellow).
5- Texas Early Yellow Grano (yellow).

The fertilizers used were:

1- Control (without fertilizer).
2- Urea (46%N).
3- Organic (Elshmokh as in Annex I).

4- NPK (15:15:15).
5- Ammonium Sulphate (21% N and 24% S).

Store structure:

The store is a traditional open structure; the direction is east – West
(8 m × 4 m = 32 m²), the floor level 0.7 -1.0 m above ground to avoid flooding and to provide good aeration.
Storage at ambient temperature and relative humidity (Annex II)

Preparation of bulbs for storage:

The harvested bulbs were cured (10-15 days), and then cutting the leaves 2 cm from the neck. Cured bulbs were sorted to sound (single bulbs), double, bolted, off-type, injured and defected bulbs were discarded and sound bulbs were selected for storage experiment (bulbs total soluble solids and dry matter percentage Annex III and VI).

A sample size of 5 kg for each treatment was packed in a plastic netted sack and replicated three times.

Data collected:

The following parameters were recorded monthly:

1- Rotted bulbs (weight).
2- Sprouted bulbs (weight).
3- Infected bulbs with black mold (weight).
4- Total weight loss.

The stored bulbs were removed from the sacks; sorted and the different categories weighed and then healthy bulbs returned to the sacks. The losses were recorded as percentages.

Experimental design and Statistical analysis:

The treatments were arranged in completely randomized design (CRD) with three replications. The data were analyzed using GenStat (Computer Program) Version 4 and the means were separated using Duncan Multiple Range Test (DMRT) at $P \leq 0.05$ [19].

III. Results

Storage data for local and introduced cultivars had variations in their storability, as reflected by the parameters used:

(A) Total weight loss percentage:

This data include weight loss, rotted bulbs, sprouted bulbs and infected bulbs by black mold.

Data shown in Table 1 reflected that onion cultivars differed significantly in total weight loss percentages, cultivar Texas Early Yellow Grano reported the highest total loss percentages (36.4 and 39.4%) in the first and second month, while local cultivars and Baftaim (S) were not varied significantly in the three month, Baftaim (S) gave the lowest percentages in the three month (15.1 %, 23.4 and 27.2, respectively), whereas Kamleen and Saggai Improved had 17 % and 25% which the highest percentage among the local cultivars in the first and second month of storage. In fourth month the local cultivars Abu-Freiawa recorded 32.5 % being the lowest loss

percentage, while cultivar Kamleen had the highest loss percentage in the last two months of storage (29.7 and 36.7, respectively).

No significant affect was found among fertilizers in the mid of storage period (second and third months). Control and organic had the highest total weight loss percentage in the first month (22.3 and 20.0, respectively) and NPK had lowest percentage (18.7), while in the last month control (31.1) had the lowest total loss and NPK had (35.5) the highest percentage (table 1).

Table 1: Effects of fertilizers and onion cultivars on total weight loss during storage period (July – October):

Fertilizers	Seasons							
	2015 / 16				2016 / 17			
	First month (July)	Second month (August)	Third month (September)	Fourth month (October)	First month (July)	Second month (August)	Third month (September)	Fourth month (October)
Control	20.1 b	26.1 a	30.0 a	33.5 a	24.5 a	31.3 a	30.2 a	30.2 a
Urea	16.2 a	22.6 a	27.0 a	35.0 a	22.6 a	27.4 a	29.2 a	29.9 a
Organic	14.1 a	26.4 a	29.6 a	32.4 a	25.9 a	30.1 a	27.7 a	29.9 a
NPK	15.7 a	24.8 a	28.3 a	37.0 a	21.8 a	26.5 a	28.1 a	29.0 a
Ammonium Sulphat	16.1 a	24.5 a	30.7 a	32.2 a	22.2 a	30.0 a	27.5 a	30.0 a
Sig. l.	**	NS	NS	NS	NS	NS	NS	NS
LSD	2.79	3.66	6.20	11.46	3.36	4.66	2.55	3.12
Cultivar								
Baftaim (S)	11.1 a	22.5 a	28.0 a	27.2 ab	19.1 a	24.3 a	26.6 a	29.0 a
Saggai Improved	11.3 a	21.5 a	25.1 a	25.9 ab	19.2 a	27.5 a	29.3 a	28.2 a
Abu-Freaiwa	9.8 a	22.8 a	26.5 a	24.2 a	21.5 a	24.4 a	29.6 a	29.1 a
Kamleen	14.0 b	19.0 a	30.4 a	31.7 b	20.9 a	29.1 a	28.9 a	32.6 a
Texas Early Yellow Grano	36.2 c	38.7 b	35.7 b	60.9 c	36.4 b	40.0 b		
Sig. l.	***	***	***	***	***	***	NS	NS
LSD	2.67	3.70	4.96	6.47	3.86	5.61	3.59	5.02
C.V.%	22.0	20.2	23.1	25.8	22.4	26.2	16.8	22.6

N.B.: NS, *, ** and ***, non significant at P=0.05 and significant at P=0.05, P=0.01 and P=0.001 respectively.

Means with similar letter (s) in the same column are not significant difference at P=0.05 according to DMRT.

(B) Rotted bulbs percentage:

Table 2 shows significant differences among onion cultivars in the first and second month, the highest percentage of rotting was with cultivar Texas Early Yellow Grano 3.4 and 3.6, whereas Baftaim (S) and local cultivars had the lowest percentage of rotted bulbs less than 2% in the first and second month. In the third and fourth month the Baftaim (S) and local cultivars were not varied significantly.

Fertilizers were varied significantly in the first month, NPK (1.6%) had the lowest percentage of rotted bulbs, and while organic the recorded (2%) was the highest percentage. The second, third and last month the effect of fertilizers on rotted bulbs percentage were not significant (table 2).

Table 2: Effects of fertilizers and onion cultivars on percentage of rotted bulbs during storage period (July – October):

Fertilizers	Seasons							
	2015/16				2016/17			
	First month (July)	Second month (August)	Third month (September)	Fourth month (October)	First month (July)	Second month (August)	Third month (September)	Fourth month (October)
Control	1.7 a	2.0 a	2.2 a	2.2 a	2.0 ab	2.5 a	2.2 a	1.7 a
Urea	1.6 a	1.7 a	2.5 a	2.0 a	2.0 ab	2.4 a	2.4 a	1.5 a
Organic	1.8 a	2.1 a	1.9 a	2.2 a	2.1 b	2.3 a	2.5 a	1.8 a
NPK	1.5 a	1.6 a	2.1 a	2.3 a	1.7 a	2.5 a	1.9 a	1.4 a
Ammonium Sulphat	1.7 a	1.9 a	2.4 a	1.9 a	1.9 a	2.5 a	2.2 a	1.8 a
Sig. l.	NS	NS	NS	NS	**	NS	NS	NS
LSD	0.29	0.43	0.72	0.70	1.21	0.52	0.52	0.42
Cultivar								
Baftaim (S)	1.3 a	1.5 a	1.6 a	1.3 a	1.4 a	2.0 a	2.4 a	1.7 a
Saggai Improved	1.3 a	1.3 a	1.8 ab	1.9 b	1.6 a	2.3 a	2.2 a	1.5 a
Abu-Freaiwa	1.3 a	1.5 a	2.4 b	2.0 b	1.7 a	2.3 a	2.3 a	1.6 a
Kamleen	1.2 a	1.4 a	1.8 ab	1.2 a	1.6 a	2.0 a	2.1 a	1.8 a
Texas Early Yellow Grano	3.3 b	3.6 b	3.5 c	4.3 c	3.5 b	3.6 b		
Sig. l.	***	***	***	***	***	***	NS	NS
LSD	0.22	0.34	0.68	0.41	0.31	0.41	0.48	0.36
C.V.%	18.3	25.4	41.6	26.7	22.0	23.0	28.9	29.6

N.B.: NS, *, ** and ***, non significant at P=0.05 and significant at P=0.05, P=0.01 and P=0.001 respectively.

Means with similar letter (s) in the same column are not significant difference at P=0.05 according to DMRT.

(C) Sprouted bulbs percentage:

The introduced cultivar Texas Early Yellow Grano had the highest percentage of sprouted bulbs (1.5 and 1.9) in the first and second month, while the cultivar Saggai Improved and Abu-Freaiwa gave the highest percentages in the third and fourth months (1.6). The cultivar Baftaim (S) gave the lowest percentages of sprouted bulbs during the storage period (1.0, 1.1, 1.0 and 1.7), the percentage of sprouting in all cultivars increased with increased of storage period (table 3).
Table 3 shows significant difference among fertilizers in the first month, ammonium sulphate was the lowest percentage of sprouted bulbs (1.1), while NPK gave (1.4) the highest percentage. The last three months fertilizers effect was not significant.

(D) Infected bulbs by black mold (*Aspergillus niger*):

As shown in Table 4 onion cultivars significant difference, cultivar Texas Early Yellow Grano and Abu-Freiawa had the lowest infected bulbs (1.1 %) in the first month; also the lowest percentage was with cultivar Abu-Freiawa (1.4, 1.1 and 2.3 %) in the second, third and fourth month and cultivars Saggai Improved and Baftaim (S) not varied significantly from Abu-Freiawa

in the second, third and fourth month. Cultivar Kamleen had highest percentages of infected bulbs in all four months of storage (1.7, 1.8, 1.7 and 3.5 %, respectively).

No significant affect was observed from the fertilizers on black mold infected bulbs percentage in the second, third and fourth month during storage. In the first month significant difference among fertilizers was found, organic (1.2 %) had the lowest percentage of infected bulbs, while the highest percentage (1.5%) was obtained by urea and ammonium sulphat (table 4).

Table (3): Effects of fertilizers and onion cultivars on sprouted bulbs percentage during storage period (July – October):

Fertilizers	Seasons							
	2015/16				2016/17			
	First month (July)	Second month (August)	Third month (September)	Fourth month (October)	First month (July)	Second month (August)	Third month (September)	Fourth month (October)
Control	1.2 a	1.6 a	1.3 a	1.9 b	1.4 a	1.6 a	1.6 a	2.2 a
Urea	1.1 a	1.5 a	1.4 a	1.7 ab	1.2 a	1.4 a	1.6 a	2.3 a
Organic	1.2 a	1.5 a	1.2 a	1.6 a	1.3 a	1.4 a	1.5 a	2.1 a
NPK	1.3 a	1.5 a	1.1 a	1.5 a	1.4 a	1.5 a	1.4 a	1.9 a
Ammonium Sulphat	1.1 a	1.5 a	1.4 a	1.6 ab	1.2 a	1.4 a	1.5 a	2.4 a
Sig. l.	NS	NS	NS	*	NS	NS	NS	NS
LSD	0.18	0.09	0.23	0.28	0.22	0.42	0.44	0.72
Cultivar								
Baftaim (S)	1.0 a	1.5 a	1.1 a	1.2 a	1.0 a	1.0 a	1.0 a	1.4 a
Saggai Improved	1.1 a	1.5 ab	1.3 a	2.2 c	1.5 b	1.5 b	1.9 c	2.4 b
Abu-Freiawa	1.2 a	1.6 bc	1.5 a	2.2 c	1.3 ab	1.3 ab	1.7 c	2.3 b
Kamleen	1.0 a	1.5 ab	1.3 a	1.7 b	1.3 ab	1.5 ab	1.4 b	2.8 b
Texas Early Yellow Grano	1.5 b	1.6 c	1.3 a	1.1 a	1.4 b	2.1 c		
Sig. l.	***	**	NS	***	*	***	***	***
LSD	0.17	0.08	0.31	0.30	0.30	0.41	0.28	0.57
C.V.%	20.2	7.4	32.7	24.5	31.4	38	25.1	35.3

N.B.: NS, *, ** and ***, non significant at P=0.05 and significant at P=0.05, P=0.01 and P=0.001 respectively.

Means with similar letter (s) in the same column are not significant difference at P=0.05 according to DMRT.

Table (4): Effects of fertilizers and onion cultivars on effected bulbs by Aspergillus during storage period (July – October):

Fertilizers	Seasons							
	2015/16				2016/17			
	First month (July)	Second month (August)	Third month (September)	Fourth month (October)	First month (July)	Second month (August)	Third month (September)	Fourth month (October)
Control	1.3 a	1.6 a	2.3 a	2.5 a	1.4 a	1.6 a	1.5 a	1.3 a
Urea	1.5 a	1.7 a	2.2 a	3.2 a	1.4 a	1.6 a	1.1 a	1.2 a
Organic	1.1 a	1.4 a	2.3 a	3.0 a	1.3 a	1.5 a	1.2 a	1.3 a
NPK	1.2 a	1.6 a	2.3 a	3.2 a	1.3 a	1.6 a	1.2 a	1.3 a
Ammonium Sulphat	1.5 b	1.8 a	2.4 a	3.0 a	1.5 a	1.5 a	1.3 a	1.3 a
Sig. l.	**	NS	NS	NS	NS	NS	**	NS
LSD	0.22	0.38	0.55	0.71	0.36	0.27	0.49	0.33
Cultivar								
Baftaim (S)	1.5 bc	1.5 ab	2.2 b	2.2 a	1.5 bc	1.6 b	1.1 a	1.3 a
Saggai Improved	1.2 ab	1.5 ab	2.5 b	2.5 a	1.4 bc	1.7 b	1.2 a	1.2 a
Abu-Freiawa	1.1 a	1.3 a	2.4 b	2.5 a	1.2 ab	1.5 b	1.1 a	1.3 a
Kamleen	1.6 c	1.7 bc	3.5 c	3.4 b	1.8 c	1.9 b	1.7 b	1.3 a
Texas Early Yellow Grano	1.2 ab	2.1 c	1.0 a	4.4 c	1.0 a	1.1 a		
Sig. l.	**	**	***	***	**	**	**	NS
LSD	0.27	0.37	0.58	0.54	0.39	0.43	0.33	0.38
C.V.%	28.1	31.0	34.8	24.5	38.6	37.9	36.1	40.3

N.B.: NS, *, ** and ***, non significant at P=0.05 and significant at P=0.05, P=0.01 and P=0.001 respectively.

Means with similar letter (s) in the same column are not significant difference at P=0.05 according to DMRT.

IV. DISCUSSION

The results of study showed marked differences among local and introduced cultivars with respect to storability.

Rotting, sprouting, weight loss and black mold were considered the most important factors to evaluate onion cultivars storability in traditional store in Sudan.

Introduced cultivar Texas Early Yellow Grano had the highest rotting, sprouting, , it lost more than 30% in the first month (July), the total loss reach to 100% after two months in traditional store, Texas Early Yellow Grano yielded highest than local cultivars with low total soluble solids and dry matter content. Baftaim (S) out-yielded the local cultivars, moderate total soluble solids and high dry matter content, it is also reported the lowest rotting, infected bulbs by black mold and total loss in the beginning of storage period (first and second months (July and August)), whereas it the lowest percentage of sprouting during the storage period. Local cultivars which high total soluble solid and dry matter, Saggai Improved and Abu-Freiawa recorded the lowest percentage of total weight loss in the last month of storage, highest percentage of sprouting and lowest infected bulbs by black mold, on the other hand Kamleen was the highest percentage of infected bulbs by black mold. Similar result obtained by [20], [21] and [22] were reported that

the variations in storability among onion cultivars ability of bulbs storage is a cultivar-specific genetic trait.

Also [23], [24], [25] and [26] reported that long day cultivars which often long dormancy period, small bulb neck, low water loss and high dry matter. Poor storing onions are generally short day cultivars which often (but not always) of short dormancy period, break dormancy quickly if stored at high temperature, large bulb neck, high water loss after harvest and low dry matter. [27] Reported that locally adapted onion cultivars were selected over many years within the tropics and they tend to store better than the short day cultivars imported from external sources.

Local onion cultivars store better than introduced cultivar Texas Early Yellow Grano, this results confirmed by [16] who stated that most of the Sudanese onion cultivars are characterized by high dry matter content, pungent with high total soluble solids and high storability, they can be store up to 5- 6 months in traditional stores, whereas the American cultivar Texas Early Yellow Grano with low pungency, low dry matter content and low storability, it lost about 50% from original weight during one month after harvest and may reach 100% after two months in traditional store. Also [28] reported that Elhilo, Abu-Freaiwa and Baftaim (S) stored successfully under traditional storage structures up to six months. This finding agree with [29] who reported that the Sudanese onion local cultivars had the best keeping quality and storability, they store well for six months, the next were the Indian cultivars for four months, while the American cultivars had the least keeping quality and storability. The mean monthly percent increase in weight loss increased from 7.8 in July to 24.2 in October, while the American cultivars sprouted with relatively higher percentage during the first month of storage, no sprouting was observed in local cultivars during the first month of storage and remained low during the second month, also local cultivars had the least mean monthly average.

V. Conclusions

From the results obtained of study, the following conclusions can be drawn:

1- Baftaim (S) reported the lowest rotting, infected bulbs by black mold and total loss in the beginning of storage period (first and second months (July and August)), whereas it the lowest percentage of sprouting during the storage period.
2- Local cultivars Saggai Improved and Abu-Freaiwa recorded the, highest percentage of sprouting and lowest infected bulbs by black mold.
3- The highest percentage of infected bulbs by black mold gave by cultivar Kamleen.
4- Introduced cultivar Texas Early Yellow Grano had the highest rotting, sprouting, , it lost more than 30% in the first month (July), the total loss reach to 100% after two months in traditional store.
5- Onion bulbs storability was not affected by different fertilizers, except in the first month.

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Annex (I): Compost Elshomokh Analysis:

Humidity	31
Ph	7.65
ECe	1.7
Ca%	4
Pass Particale 2mm	53.27
Mg%	3
Na%	3
K%	5.27
P%	2.05
O.C%	26
O.M%	44.7
N%	1.4
C/N	18.8
Cu ppm	0.536
Fe ppm	149.725
Mn ppm	4.953
S ppm	141.773

Data source: Project of Shomokh Eltabya Organic fertilizer factory.

Annex (II): Monthly mean maximum and minimum air temperature (°C), relative humidity (%) and total rainfall at Shambat during storage seasons 2016-2017.

Month	2016				2017			
	Mean Temperature (C°)		Relative humidity (%)	Total Rain fall (MM)	Mean Temperature (C°)		Relative humidity (%)	Total Rain fall (MM)
	Max.	Min.			Max.	Min.		
July	41.5	26.2	31	TR	39.9	26.5	42	40.4
August	37.9	25.6	47	72.5	36.6	24.8	52	0.0
September	39.2	25.2	63	23.0	39.3	26.5	42	2.5
October	40.2	24.6	32	TR	39.4	24.3	27	0.0
November	36.0	21.4	31	0.0	34.8	20.8	30	0.0

Source: Ministry of Environment, Forestry and Physical Development Meteorological Authority Weather – climate data.

Shambat Metrological Station.

Annex (III): Effects of fertilizers and onion cultivars on total soluble solid (T.S.S.):

Fertilizers	Season		Mean
	2015/16	2016/17	
Control (without fertilizer)	12.91 a	11.43 a	12.17 a
Urea (46%N)	12.51 a	11.62 a	12.07 a
Organic (Elshmokh)	11.91 a	11.47 a	11.69 a
NPK (15:15:15)	12.12 a	11.62 a	11.87 a
Ammonium Sulphate (21%N&24%S)	12.34 a	12.05 a	12.20 a
Fertilizers LSD	0.758		0.5361
Cultivars			
Baftaim (S)	12.91 a	11.72 a	12.32 c
Saggai lmproved	13.20 a	12.61 a	12.91 b
Abu-Freiwa	13.58 a	13.16 a	13.37 b
Kamleen	15.01 a	13.81 a	14.41 a
Texas Early Yellow Grano	7.09 a	6.89 a	6.99 d
Cultivars LSD	0.758		0.5361
C.V.%	8.7		

N.B.: NS, *, ** and ***, non significant at P=0.05 and significant at P=0.05, P=0.01 and P=0.001 respectively.

Means with similar letters are not significant at P=0.05 according to DMRT.

Annex (VI) :Effects of fertilizers, onion cultivars and their interactions on percentage dry matter of bulbs:

Fertilizers	Season		Mean
	2015/16	2016/17	
Control (without fertilizer)	14.26 a	12 58 a	13.42 a
Urea (46%N)	13.90 a	14.07 a	13.98 a
Organic (Elshmokh)	14.17 a	12.87 a	13.52 a
NPK (15:15:15)	13.72 a	13.66 a	13.69 a
Ammonium sulphat (21%N&24%S)	13.63 a	12.61 a	13.16 a
SE±	0.285	0.601	0.328
Cultivars			
Baftaim (S)	13.93 c	13.24 c	13.58 c
Saggai lmproved	15.18 b	15.25 ab	15.22 b
Abu-Freaiwa	15.73 b	14.06 bc	14.89 b
Kamleen	17.32 a	16.29 a	16.88 a
Texas Early Yellow Grano	7.52 d	7.04 d	7.28 d
SE±	0.285	0.601	0.328
Fertilizers * Cultivars			
Control* Baftaim (S)	14.28 a	13.28 bcd	13.78 cde
Control* Saggai lmproved	15.53 a	14.27 bcd	14.90 bcde
Control* Abu-Freaiwa	15.18 a	15.69 b	15.43 bcd
Control* Kamleen	19.43 a	12.55 bcd	15.99 bc
Control* Texas Early Yellow Grano	6.85 a	7.12 ef	6.99 f
Urea (46%N) * Baftaim (S)	14.04 a	10.95 cde	12.49 e
Urea (46%N) * Saggai lmproved	14.87 a	14.57 bcd	14.72 bcde
Urea (46%N) * Abu-Freaiwa	15.27 a	14.62 bcd	14.95 bcd
Urea (46%N) * Kamleen	17.45 a	23.34 a	20.40 a
Urea (46%N) * Texas Early Yellow Grano	7.85 a	6.86 ef	7.36 f
Organic (Elshmokh) * Baftaim (S)	14.84 a	13.48 bcd	14.16 bcde
Organic (Elshmokh) * Saggai lmproved	15.70 a	15.15 bc	15.42 bcd
Organic (Elshmokh) * Abu-Freaiwa	15.82 a	13.23 bcd	14.52 bcde
Organic (Elshmokh) * Kamleen	16.70 a	15.37 bc	16.03 bc
Organic (Elshmokh) * Texas Early Yellow Grano	7..82 a	7.13 ef	7.47 f
NPK (15:15:15) * Baftaim (S)	13.77 a	12.25 bcd	13.01 de
NPK (15:15:15) * Saggai lmproved	14.96 a	16.86 b	15.91 bc
NPK (15:15:15) * Abu-Freaiwa	16.66 a	16.22 b	16.44 b
NPK (15:15:15) * Kamleen	16.35 a	15.27 bc	15.81 bc
NPK (15:15:15) * Texas Early Yellow Grano	6.87 a	7.69 ef	7.28 f
Ammonium sulphate (21%N&24%S) * Baftaim (S)	12.72 a	16.24 b	14.48 bcde
Ammonium sulphate (21%N&24%S) * Saggai lmproved	14.84 a	15.40 bc	15.12 bcd
Ammonium sulphate (21%N&24%S) * Abu-Freaiwa	15.71 a	14.06 def	13.12 de
Ammonium sulphate (21%N&24%S) * Kamleen	16.66 a	14.92 bcd	15.79 bc
Ammonium sulphate (21%N&24%S) * Texas Early Yellow Grano	8.21 a	6.40 f	7.30 f
SE±	0.637	1.344	0.735
C.V.%	7.9	17.7	18.5

N.B.: NS, *, ** and ***, non significant at P=0.05 and significant at P=0.05, P=0.01 and P=0.001 respectively.

Means with similar letter (s) in the same column are not significant difference at P=0.05 according to DMRT.

