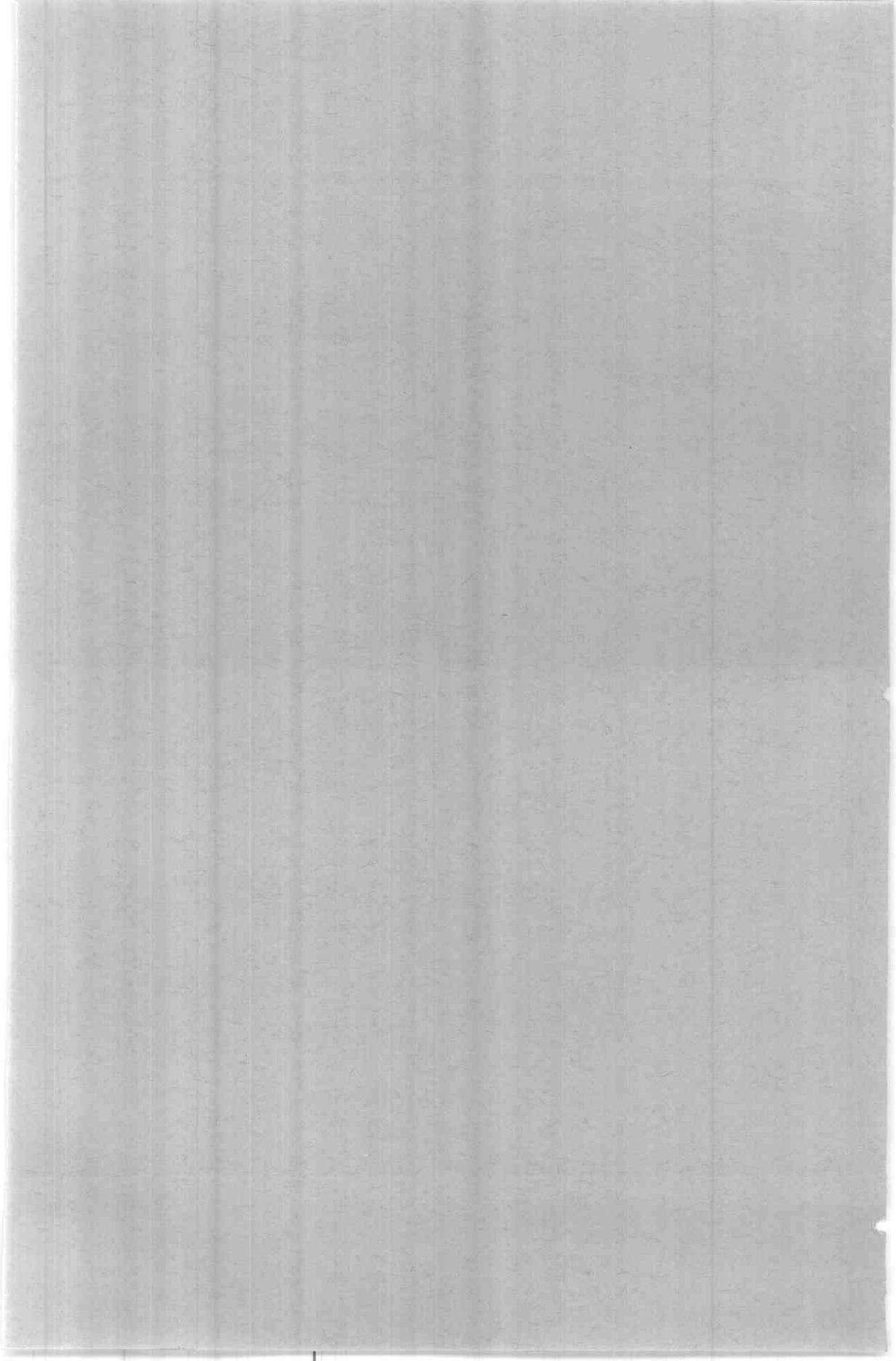
RESULTS AND DISCUSSION



IV. RESULTS AND DISCUSSION

IV.1.Cytological studies:

IV.1.1. Chromosomal behaviour:-

It was observed that the meiotic behavior of the Jaffa orange cultivar was nearly normal in all respects. Leptotene chromosomes were long and slender, darkly stained was regularly seen attached to one of the chromosomes. In the pachytene stage, the chromosomes were distinctly thicker. Homologous chromosomes showed complete synapses. In diplotene stage, the chromosomes were much thicker and shorter than in previous stages. Diakinesis stage is characterized by disappearance of the nucleus and by distribution of the nine bivalent throughout the nucleus. At first metaphase the chromosomes were grouped in the center. Most of the cells examined, showed the presence of nine bivalent but trivalent or quadrated were not observed. At the first anaphase the nine bivalent seperated into two sets of nine chromosomes each. At the beginning of first telophase, the chromosomes were grouped so closely at the two haploid nuclei which were not accompanied, by the formation of the cell wall. The two remained nuclei in a common mass of the cytoplasm and went under the second meiotic division. The end result of this division was the production of four haploid nucleic each surrounded by

cell wall within the spore mother cell. The wall of the mother cell, however soon disintegrated leaving the microspores free in the cavity of the anther.

IV.1.1.1. Meiosis in the Hamlin orange cultivar *(Citurs sinensis):*

It was found that the meiotic behavior of the Hamlin orange cultivar was normal in all respects. The details of chromosome pairing were studied at late diakinesis and first metaphase. **Table (1)** shows the various chromosomal associations. The percentage of pollen mother cells of the Hamlin showing nine bivalents was 72.12% and 74.58% during both seasons. The percentage of pollen mother cells with univalent was 27.88 and 25.42%.

IV.1.1.2. Meiosis in the Jaffa orange cultivar (*Citrus sinensis*):

The chromosome pairing was examined at late diakinesis and first metaphase. **Table (1)** shows the chromosomal behavior. The percentage of pollen mother cells of the Jaffa orange cultivar revealing nine bivalentss was 65.78 and 62.60% during both seasons. The next frequent associations were 8 bivalents plus 2 univalent and 7 bivalents plus 4 univalent. From the **Table (1)** it is clear that the percentage of pollen mother cells with univalent was 34.22% and 37.40% during both seasons.

It was found that the haploid number of chromosomes in the Citrus cultivars studied was nine chromosome, while the diploid number was eighteen. Such results agree with those obtained by **Traub** and **Robinson (1937), Kadelaki (1938), Gustafson (1947), Frost (1938)** and **(1943), Krug (1943), Banerji (1954), Mukherjee** and **Cameron (1958), Raghuvanshi (1962-a)** and **Iwamasa (1968).** They reported that in the cultivated species and varieties of Citrus which they examined, the haploied number of chromosomes was nine and the diploied number was eighteen.

The chromosome behavior at meiosis in each of these cultivars showed, that nine bivalents appeared, at late diakinesis and first metaphase stages. In two cultivars studied there were univalent chromosomes beside the bivalents in some pollen mother cells in different proportions. This seems to agree with the findings of **Raghuvanshi (1962-b)** who observed univalent chromosomes in seventeen species and varieties of Citrus in different proportions.

In general more pollen mother cells with univalent chromosomes were observed, in two cultivars of Citrus. **and Frost (1943)** stated that, irregular meiotic division was a characteristic feature of most species hybrids. **Nielsen (1956)** found, that the meiosis in pollen mother cells of natural Agroelymus hybrid was relatively regular with moderately low

frequencies of lagging univalent during chromsome division. **Raghuvanshi (1962-b)** found that the presence of univalent chromosomes in Citrus karna, Mayer lemon and Rangpur lime, appears to be due to their hybrid origin.

The common number of univalent chromosomes' appeared in the pollen mother cells of the cultivars of Citrus were two or four, which seems to agree with the findings of **Raghuvanshi (1962-b)** and **Iwamasa (1968).** They reported that, two or four univalent chromosomes occurred, commonly in some pollen mother cells of many Citrus species and. varieties.

The univalent chromosomes disturbs the meiotic cycle as they lag behind and these may not include in daughter nuclei resulting in the abortion of pollen mother cell products. **Sharp (1943)** stated that, the bivalents disjoin normally, but univalent chmromosomes either pass in various numbers to the poles or undergo equation division. Further irregularity follows in the second division, so that numerous abnormal complements and much sterility result. Irregularity in chromosome distribtition often leads to the formation of microspore groups comprising spores varying in size and number (polyspory) instead of normal quartets. **Raghuvanshi (1962-a)** reported that, due to uncertain behavior of univalent chromosomes which was observed in a large number of pollen mother cells in ***Citrus assamensis***, the telophasic plates found to possess varying number of

chromosomes. The univalent chromosomes were sometimes left in the cytoplasm where they are ultimately lost. This leads to deficiency of chromatin material in some nuclei. Also, due to irregular separation, some chromosomes may be duplicated in the same pole, while the other becomes deficient for one. These various abnormalities lead to pollen sterility.

None of the pollen mother cells examined in these Citrus cultivars showed any multivalent chromosomes. This may be expected as these cultivars are considered to be diploids with a haploid chromosome number of nine. **Darlington (1937)** and **Dobzhansky (1941)** stated that, the number of bivalent chromosomes is equal to the haploid chromosome number.

No fragments or chromatin bridges were observed in the anaphases of these meiotic divisions. This may show that, the Citrus cultivars studied in these investigations did not carry any fragments. This seems to agree with the findings of **Kitat (1959)** who reported that, no fragments or chromatin bridges were observed in ***Citrus aurantifolia, Citrus limetica*** and ***Citrus sinensis***. However, **Naithani and Raghuvanshi (1963)** during their studies on the cytological basis of speciation in the genus Citrus found that, both the segmental interchange and inversions seetied to have played an important part in the speciation of the genus Citrus. The most remarkable example of the first type was

afforded by ***Citrus assamensis*** and the second type by *Citrus limonia* var, Italian round.

The data of the average number of univalent chromosomes during meiosis in these Citrus cultivars revealed that, Citrus cultivars differed considerably in the presence of univalent chromosomes.

Raghuvanshi (1962-b) found that, the average number of univalent chromosomes per pollen mother cell in the grapefruit ***(Citrus Paradisi*** var. Marsh), ***Citrus reticulata*** var. Lyalpur and ***Citrus sinensis*** var. Malta was 1.12, 0.16 and 0.20, respectively. He did not find univalent chromosomes in the Shaddock ***Citrus grandis*** var. Red flesh, the Ruby grapefruit) ***Citrus paradisi*** var. Ruby) and ***Citrus reticulata*** var. Satsuma Mikan.

Madbouly (1969) found that, the Citrus hybrids which showed the maximum average number of univalent chromosomes per pollen mother cell were the hybrids of the Clementine tangerine x the Shaddock. The Citrus hybrids which showed the minimum average number of univalent chromosomes per pollen mother cell were the hybrids of the Clementine tangerine x the Balady blood orange. The Citrus hybrids which showed the median avcrage number of univalent chromosomes per pollen mother cell were the hybrids of the Clementine tangerine x the Buncan grapefruit and the hybrids of

the Clementine tangerine x the Marsh grapefruit. **Raghuvanshi (1962-b)** found that the average number of univalent chromosomes per pollen mother cell in ***Citrus kama*** (natural hybrid), Rusk (an intergeneric hybrid between Citrus and ***Poncirus trifoliata),*** Rangpur lime (natural hybrid), and meyer lemon (natural hybrid between ***Citrus sinensis*** and ***Citrus limonia***.) was *1.52,* 1.08, 0.24 and 0.28, respectively.

Table (1) Types of chromosomal pairing at Diakinesis and Metaphase I stages of meiosis in Jaffa and Hamlin orange cultivars (2002 and 2003 seasons)

2002								
Cultivars	Number of examied cells	Diakinesis and Metaphase Pairing					Percentage of cells with 9 Bivalents	Percentage of cells with univalents
		9_{II}	$8_{II}+2_{I}$	$7_{II}+4_{I}$	$6_{II}+6_{I}$	$5_{II}+8_{I}$		
Jaffa	263	173	57	24	9	-	65.78	34.22
Hamlin	312	225	60	20	6	1	72.12	27.88
2003								
Cultivars	Number of examied cells	Diakinesis and Metaphase Pairing					Percentage of cells with 9 Bivalents	Percentage of cells with univalents
		9_{II}	$8_{II}+2_{I}$	$7_{II}+4_{I}$	$6_{II}+6_{I}$	$5_{II}+8_{I}$		
Jaffa	377	236	96	31	13	1	62.60	37.40
Hamlin	295	200	51	18	5	1	74.58	25.42

IV.1.2. Pollen fertility:

Regarding the pollen fertility as indicated by examining the morphology and stainability of pollen grains, it was found that the fertility of pollen in these cultivars of Citrus varied considerably. In the two cultivars there are different degrees of pollen abortion **(Table 2)**. This seems to agree with the findings of **Raghuvanshi (1962-b),** he reported that, different degrees of pollen abortion in many Citrus species and Citrus hybrids.

Cultivar which showed the maximum percentage of pollen fertility was, the Hamlin with a percentage of 62.18 and 66.70%. Cultivar which showed the minimum percentage of pollen fertility was Jaffa with a percentage of 46.01 and 43.42%. **Raghuvanshi (1962-b)** found that, the percentage of pollen fertility of the Shaddock (***Citrus grandis*** var. Red flesh), the Ruby grapefruit (***Citrus paradisi*** var. Huby), ***Citrus reticulata*** var. Lyalpur, ***Citrus sinensis*** var. Malta, and the Marsh grapefruit, was 95.00, 96.00, 83.00, 81.00 and 14.00, respectively.

Longley (1925) found that, about five sixths of the pollen grains in the Marsh grapefruit were empty, **Soost (1955)** found that, seedless varieties of grapefruit have approximately, 15 percent good pollen grains.

Table (2) Percentages of stainability and germination of pollen grains in Jaffa and Hamlin orange cultivars (2002 and 2003 seasons).

2002						
Cultivars	Stainable pollen			Germination pollen		
	Total Number of pollen tested	Stainable pollen		Total number of pollem tested	Number of germinated pollen	Av. % germinated
		No. of stainable	Av.% stainable			
Jaffa	2354	1083	46.01	1793	279	15.56
Hamlin	2467	1534	62.18	2145	436	20.33
2003						
Cultivars	Stainable pollen			Germination pollen		
	Total Number of pollem tested	Stainable pollen		Total number of pollem tested	Number of germinated pollen	Av. % germinated
		No. of stainable	Av.% stainable			
Jaffa	2681	1164	43.42	2437	416	17.07
Hamlin	2793	1863	66.70	2614	624	23.87

IV.2. Effect of growth regulators on vegetative growth:

IV.2.1. Leaf length:

- Specific effect:

Data presented in **Table (3)** show clearly that, leaf length of Hamlin and Jaffa orange cultivars was significantly influenced by specific effect of both investigated factors i.e., growth regulators and cultivars. Herein, CPPU at 10 or 20 ppm showed statistically higher leaf length than other treatments during both experimental 2002 and 2003 seasons. Leaf length during both seasons recorded (4.27 and 4.40 cm) and (4.24 and 4.23 cm) in CPPU at 10 ppm and 20 ppm, respectively. As for the specific effect of cultivars, it was quite evident that Jaffa cultivar surpassed statistically Hamlin cultivar ones in this repect. Wherease, leaf length of Jaffa reached (5.11 & 5.13 cm) during 1st and 2nd seasons, respectively that corresponding to (3.28 & 3.27) with Hamlin cultivar.

- Interaction effect:

Table (3) display obviously that, specific effect of each investigated factor was directly reflected on their various combination. In the other word, treatment with CPPU at 10 ppm + GA_3 at 200 ppm leaf length for a givn Hamlin and Jaffa cultivars was significantly highest than the other interactions.

Such trend was true during both 2002 and 2003 experimental seasons.

These results are in line with **Abo EI-Komsan (1978); Vu** and **yelenosky (1988)** and **Kalabandi *et al.*, (2003).**

Table (3): Effect of Sitofex (CPPU) and gibberellic acid ($GA_{3)}$ applications on leaf length (cm) of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	5.91 k	9.81 f	**7.86 E**	6.17 g	10.01 d	**8.08 F**
CPPU at 10 ppm	5.41 l	9.70 g	**7.55 F**	6.10 g	9.99 d	**8.05 F**
CPPU at 20 ppm	5.32 m	9.78 g	**7.50 F**	6.11 g	9.94 d	**8.03 F**
GA_3 at 100 ppm	6.71 i	10.46 b	**8.95 D**	7.13 f	10.61 c	**8.87 DE**
GA_3 at 200 ppm	6.84 h	11.33 a	**9.09 A**	7.61 e	11.70 a	**9.65 A**
CPPU at 10 ppm + GA_3 at 100 ppm	6.34 j	11.15 c	**6.74 C**	6.98 f	10.67 c	**8.82 E**
CPPU at 10 ppm + GA_3 at 200 ppm	6.29 j	11.22 bc	**8.76 BC**	6.99 f	11.14 b	**9.07 C**
CPPU at 20 ppm + GA_3 at 100 ppm	6.71 i	10.90 d	**8.80 B**	7.01 f	11.01 b	**9.01 CD**
CPPU at 20 ppm + GA_3 at 200 ppm	6.92 h	11.24 b	**9.08 A**	7.14 f	11.66 a	**9.40 B**
Mean **	**6.27 B**	**10.61 A**		**6.81 B**	**10.75 A**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.2.2. Leaf wedith:

- Specific effect:

As for the specific effect of growth regulators, **Table (4)** displays that, the leaf width was highest when treatment with CPPU at 20 ppm + GA_3 at 200 ppm rather than other treatments and the control.

The response of specific effect of cultivars was obviously noticed, wherease Jaffa cultivar surpassed statistically Hamlin cultivar during two seasons of study in this respect.

- Interaction effect:

Regarding the interaction effect of various (growth regulators x orange cultivars) combinations, **Table (4)** reveald that Jaffa cultivar treated with CPPU at 20 ppm + GA_3 at 200 ppm had significantly the widthest leaf. Meanwhile, the reverse was true with Hamlin cultiva treated with CPPU at 10 ppm. In addition, other combinations were in between the aforesaid two extrems. Differences were significant as compared combinations of every category each other. The obtained results are in confirm with **Staffens *et al.*, (1984); Swietlk (1986) and Modesto *et al.*, (1999).**

Table (4): Effect of sitofex (CPPU) and gibberellic acid ($GA_{3)}$ applications on leaf width (cm.) of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	3.17 n	4.94 g	**4.06 H**	3.11 n	5.10 ef	**4.10 H**
CPPU at 10 ppm	3.41 i	5.13 d	**4.27 B**	3.47 i	5.08 fg	**4.27 B**
CPPU at 20 ppm	3.61 h	5.18 b	**4.40 A**	3.58 h	5.07 g	**4.32 A**
GA_3 at 100 ppm	3.20 lm	5.10 e	**4.15 E**	3.16 m	5.11 de	**4.14 G**
GA_3 at 200 ppm	3.18 mn	5.09 e	**4.13 F**	3.18 lm	5.13 cd	**4.15 F**
CPPU at 10 ppm + GA_3 at 100 ppm	3.21 l	5.01 f	**4.11 G**	3.27 k	5.18 b	**4.22 C**
CPPU at 10 ppm + GA_3 at 200 ppm	3.29 j	5.21 a	**4.25 C**	3.30 j	5.23 a	**4.26 B**
CPPU at 20 ppm + GA_3 at 100 ppm	3.26 k	5.14 cd	**4.20 D**	3.20 l	5.14 c	**4.17 E**
CPPU at 20 ppm + GA_3 at 200 ppm	3.17 n	5.16 c	**4.16 E**	3.19 l	5.18 b	**4.19 D**
Mean **	**3.28 B**	**5.11 A**		**3.27 B**	**5.13 A**	

* and ** refer to specific effect of growth regulators and cultivars, respectively

IV.2.3. Leaf shape index:

- Specific effect:

Data obtained during both seasons as shown in **Table (5)** cleared that, however the same trends of response rgarding the specific effect of both (growth regulators and orange cultivars) previously discussed with

the leaf length and width were also detected for leaf shape index.

- Interaction effect:

It was so clear that, the response of leaf shape index to the differential investigated combinations between two investigated factors (growth regulators x orange cultivars) followed generally the same trend previously detected with leaf length and leaf width during both seasons under study.

A similar result was also obtained by **Singh *et al.*, (2000) and Kalabandi *et al.*, (2003).**

Table (5): Effect of Sitofex (CPPU) and gibberellic acid ($GA_{3)}$ applications on leaf shape index of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	1.86 i	1.98 g	**1.92 E**	1.98 g	1.96 h	**1.97 E**
CPPU at 10 ppm	1.58 j	1.89 h	**1.74 F**	1.75 i	1.96 h	**1.86 F**
CPPU at 20 ppm	1.47 k	1.88 i	**1.67 G**	1.70 j	1.95 h	**1.83 G**
GA_3 at 100 ppm	2.09 e	2.04 f	**2.07 C**	2.25 c	2.07 f	**2.16 C**
GA_3 at 200 ppm	2.15 c	2.22 a	**2.19 A**	2.39 a	2.28 b	**2.33 A**
CPPU at 10 ppm + GA_3 at 100 ppm	1.97 g	2.22 a	**2.10 B**	2.13 e	2.12 e	**2.13 D**
CPPU at 10 ppm + GA_3 at 200 ppm	1.90 h	2.17 b	**2.04 D**	2.11 e	2.13 e	**2.12 D**
CPPU at 20 ppm + GA_3 at 100 ppm	2.05 f	2.11 d	**2.08 B**	2.19 d	2.14 e	**2.16 C**
CPPU at 20 ppm + GA_3 at 200 ppm	2.18 b	2.17 b	**2.18 A**	2.23 c	2.25 c	**2.24 B**
Mean **	**1.92 B**	**2.08 A**		**2.06 B**	**2.09 A**	

*** and ** refer to specific effect of growth regulators and cultivars, respectively**

IV.2.4. Average leaf area:

- **Specific effect:**

Data presented in **Table (6)** displayed that, average leaf area respond to both investigated factors. Herein, GA_3 at 200 ppm resulted in an increase in leaf area as compared to that other treatments.

As for specific effect of orange cultivars, it is quite evident that Jaffa orange cultivar had highest leaf area than Hamlin orange cultivar during both seasons of the study.

- **Interaction effect:**

Regarding the response of leaf area to interaction effect of various combinations between growth regulators and orange cultivars, it was no clear to notice that the trend was true during the two seasons of study. Jaffa orange cultivar treated with GA_3 at 200 ppm had significantly the largest leaf area. Menwhile, the reverse was true with Hamlin orange cultivar and CPPU at 20 ppm. In addition, other combinations were in between during 2002 and 2003 seasons.

These results are in general agreement with **Staffens *et at.*, (1984); Swietlk (1986); Vu & Yelenosky (1988)** and **Thukral *et at.*, (1994).**

Table (6): Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on leaf area $(cm)^2$ of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	12.49 e	19.42 cd	**15.95 CDE**	12.73 d	33.76 c	**23.25 D**
CPPU at 10 ppm	11.93 e	18.47 d	**15.20 E**	14.05 d	33.83 c	**23.94 CD**
CPPU at 20 ppm	12.77 e	18.41 d	**15.59 DE**	14.54	33.49 c	**24.01 CD**
GA_3 at 100 ppm	14.27 e	22.81 b	**18.54 B**	14.97 d	36.11 bc	**25.54 BC**
GA_3 at 200 ppm	14.50 e	23.16 b	**18.83 B**	13.99 d	39.90 a	**26.94 AB**
CPPU at 10 ppm + GA_3 at 100 ppm	13.55 e	21.10 bcd	**17.33 BCD**	17.17 d	37.74 ab	**26.46 AB**
CPPU at 10 ppm + GA_3 at 200 ppm	13.80 e	21.80 bc	**17.80 BC**	15.38 d	38.73 ab	**27.06 AB**
CPPU at 20 ppm + GA_3 at 100 ppm	14.52 e	22.95 b	**18.74 B**	14.90 d	37.36 ab	**26.13 AB**
CPPU at 20 ppm + GA_3 at 200 ppm	21.85 bc	35.80 a	**28.73 A**	16.18 d	40.15 a	**27.67 A**
Mean **	**14.44 B**	**22.64 A**		**14.55 B**	**36.79 A**	

*** and ** refer to specific effect of growth regulators and cultivars, respectively**

IV.1.5. Leaves dry weight:

- **Specific effect:**

Referring the specific effect of growth regulators on leaves dry weight tabulated data in **Table (7)** display that the heaviest leaves was statistically exhibited by trees treated with CPPU at 20 ppm + GA_3 at 200 ppm during two seasons of study. Moreover, the specific effect of orange cultivars was obviously detected, whereas Jaffa orange cultivar exceeded statistically Hamlin orange cultivar in this respect during both seasons of study.

- **Interaction effect:**

Table (7) shows obviously that the specific effect of each investigated factor was directly reflected on interaction effect of these combinations. Herein, the heaviest dry leaves were always in concomitant to Jaffa orange cultivars and CPPU at 20 ppm + GA_3 at 200 ppm significantly followed in descending order by Jaffa orange cultivar and CPPU at 10 ppm + GA_3 at 200 ppm. Such trend was true during both seasons and differences between the aforesaid three categories were significant.

These results go in line with those obtained by **Swietlk (1986); Baku (1989)** and **Singh *et al.*, (2000).**

A similar trend was reported by **Staffens *et al.*, (1984); Yesilolu & Tuzcu (1993); Thukral *et al.*, (1994)** and **Abd El-Rahman (2003).**

Table (8):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on leaf nitrogen percentage content of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	1.98 p	2.10 o	**2.04 I**	2.45 i	2.61 h	**2.53 G**
CPPU at 10 ppm	2.89 k	3.16 g	**3.02 E**	3.55 d	3.25 d	**3.55 D**
CPPU at 20 ppm	3.12 h	3.51 e	**3.31 C**	3.71 c	3.72 bc	**3.71 C**
GA_3 at 100 ppm	2.71 e	2.92 j	**2.81 G**	2.28 j	2.57 h	**2.43 H**
GA_3 at 200 ppm	3.20 f	2.15 n	**2.68 H**	3.11 e	2.83 g	**2.97 E**
CPPU at 10 ppm + GA_3 at 100 ppm	2.66 m	3.59 d	**3.13 D**	3.06 e	2.46 i	**2.76 F**
CPPU at 10 ppm + GA_3 at 200 ppm	3.58 d	3.67 b	**3.63 B**	3.77 bc	3.98 a	**3.87 A**
CPPU at 20 ppm + GA_3 at 100 ppm	2.90 j	2.99 i	**2.95 F**	2.98 f	2.95 f	**2.97 E**
CPPU at 20 ppm + GA_3 at 200 ppm	3.64 c	3.71 a	**3.68 A**	3.79 b	3.77 bc	**3.78 B**
Mean **	**2.96 B**	**3.09 A**		**3.19 A**	**3.16 B**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.3.2. Leaf phosphorus content:

- **Specific effect:**

With regard to specific effect of each investigated factor, **Table (9)** shows that, leaf phosphorus content was influenced significantly with orange cultivar, wherese Jaffa orange cultivar showed significantly higher level than Hamlin orange cultivars during the first season, but in the second season the revers was true, Hamlin orange cultivar showed significantly highest level than Jaffa orange cultivas.

As for specific effect of growth regulators, data obtained from **Table (9)** indicated that, the treatment with CPPU at 20 ppm + GA_3 at 200 ppm gave the highest values in this respect during both seasons compared with the other treatments.

- **Interaction effect:**

Table (9) shows that, all combinations of growth regulators X orange cultivars showed too high variations in their leaf P content whereas leaves of both orange cultivars and treatment with CPPU at 20 ppm + GA_3 at 200 ppm gave the higher values during tow seasons.

These results are in agreement with findings of **Staffens *et al.*, (1984); Yesilolu & Tuzcu (1993), Thukral *et al.*, (1994)** and **Abd El-Rahman (2003).**

Table (9):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on leaf phosphorus percentage content of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	0.25 k	0.32 j	**0.28 G**	0.38 h	0.26 i	**0.33 F**
CPPU at 10 ppm	0.55 h	0.61 cd	**0.58 E**	0.61 de	0.35 h	**0.48 E**
CPPU at 20 ppm	0.59 f	0.62 c	**0.61 D**	0.64 cd	0.49 g	**0.56 D**
GA_3 at 100 ppm	0.49 i	0.57 g	**0.53 F**	0.51 fg	0.38 h	**0.45 E**
GA_3 at 200 ppm	0.60 def	0.61 cd	**0.61 D**	0.71 b	0.50 g	**0.60 C**
CPPU at 10 ppm + GA_3 at 100 ppm	0.57 g	0.59 f	**0.58 E**	0.58 de	0.47 g	**0.53 D**
CPPU at 10 ppm + GA_3 at 200 ppm	0.65 b	0.70 a	**0.68 B**	0.69 bc	0.56 ef	**0.62 BC**
CPPU at 20 ppm + GA_3 at 100 ppm	0.61 cde	0.66 b	**0.64 C**	0.63 cd	0.68 bc	**0.66 B**
CPPU at 20 ppm + GA_3 at 200 ppm	0.70 a	0.71 a	**0.70 A**	0.78 a	0.73 ab	**0.76 A**
Mean **	**0.56 B**	**0.60 A**		**0.61 A**	**0.49 B**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.3.3. Leaf potassium content:

- **Specific effect:**

With regard to the specific effect of orange cultivar on leaf K%, **Table (10)** displays that Jaffa orange cultivar had significantly richer leaves in their potassium contents as compared to Hamlin orange cultivar during both seasons of study. Meanwhile, the response to specific effect of growth regulators was relatively less pronounced than the aforesaid discussed one with orange cultivars. Anyhow, Jaffa orange cultivar had richer leaves than those of Hamlin orange cultivar as the leaf K% was concerned during 2002 and 2003 seasons.

- **Interaction effect:**

Data obtained during both seasons as shown from **Table (10)** displayed that, the specific effect of both investigated factor (orange cultivars X growth regulators) reflected on interaction effect of their combinations. Herein, the richest leaves in their K content were always in concomitant to such Jaffa orange cultivar treated with CPPU at 10 ppm + GA_3 at 200 ppm during both seasons of study. On the contrary, the least leaf K% was significantly inclosed to leaves of Hamlin orange cultivar treated with tap water (control) during both seasons of study. However, other combinations were in between. A similar conclusion was

reported by **Yesiololu and Tuzcu (1993); Thural *et al.*, (1994)** and **Abd El-Rahman (2003).**

Table (10):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on leaf potassium percentage content of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	1.31 i	1.38 i	**1.35 G**	1.40 j	2.60 c	**2.00 D**
CPPU at 10 ppm	2.36 ef	2.56 abc	**2.46 C**	2.31 g	2.71 ab	**2.52 A**
CPPU at 20 ppm	2.40 def	2.60 ab	**2.50 BC**	2.36 fg	2.40 efg	**2.38 B**
GA_3 at 100 ppm	1.91 h	2.40 def	**2.15 F**	1.94 i	2.46 def	**2.20 C**
GA_3 at 200 ppm	2.06 g	2.41 de	**2.23 E**	2.11 h	2.39 efg	**2.25 C**
CPPU at 10 ppm + GA_3 at 100 ppm	2.37 ef	2.31 f	**2.34 D**	2.38 efg	2.37 fg	**2.37 B**
CPPU at 10 ppm + GA_3 at 200 ppm	2.49 cd	2.64 a	**2.56 AB**	2.44 def	2.73 a	**2.58 A**
CPPU at 20 ppm + GA_3 at 100 ppm	2.51 bc	2.61 ab	**2.26 AB**	2.48 de	2.67 abc	**2.58 A**
CPPU at 20 ppm + GA_3 at 200 ppm	2.61 ab	2.55 abc	**2.28 A**	2.61 bc	2.51 d	**2.56 A**
Mean **	**2.22 B**	**2.38 A**		**2.23 B**	**2.54 A**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.3.4. Leaf magnessium content:

- **Specific effect:**

As for the specific effect of orange cultivars on leaf Mg content, **Table (11)** show that, Jaffa orange cultivar gave the highest values from leaf Mg content compared with Hamlin orange cultivars during both seasons of the study.

As for specific effect of growth regulators, it was quite evident that CPPU at 20 ppm + GA_3 at 100 or 200 ppm suppassed statistically other treatments in this respect during both seasons.

- **Interaction effect:**

Reffering the interaction effect of various orange cultivars X growth regulators combination, on Mg leaf content, **Table (11)** shows obviously that the richest leaves in their Mg content were always in concomitant to such Jaffa orange cultivars treated with CPPU at 20 ppm + GA_3 at 200 ppm during both seasons of study. On the contrary, the least leaf Mg content was significatnly inclosed to leaves of Hamlin orange cultivars treated with tap water (control) during 2002 and 2003 seasons.

These results are in agreement with the findings of **Thukral *et al.*, (1994); Yesiliolu** and **Tuzcu (1993)** and **Abd El-Rahman (2003)**

Table (11): Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on leaf magnessuim (ppm) content of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	121.00 o	147.70 j	**134.30 I**	134.70 o	151.30 e	**143.0 G**
CPPU at 10 ppm	148.30 j	194.30 c	**171.30 D**	167.70 i	196.70 d	**182.20 C**
CPPU at 20 ppm	134.0 e	196.30 b	**165.20 E**	149.70 m	196.70 d	**173.20 D**
GA_3 at 100 ppm	131.30 m	190.30 e	**160.80 F**	155.70 k	191.30 e	**173.50 D**
GA_3 at 200 ppm	172.70 g	196.00 b	**184.30 C**	183.30 g	199.30 b	**191.30 B**
CPPU at 10 ppm + GA_3 at 100 ppm	126.70 n	155.70 i	**141.20 H**	139.70 n	174.0 h	**158.80 F**
CPPU at 10 ppm + GA_3 at 200 ppm	144.30 k	170.70 h	**157.50 G**	156.70 j	186.30 f	**171.50 E**
CPPU at 20 ppm + GA_3 at 100 ppm	192.70 d	195.70 b	**194.20 A**	197.70 c	199.70 b	**198.70 A**
CPPU at 20 ppm + GA_3 at 200 ppm	186.70 f	198.30 a	**192.50 B**	196.30 d	201.30 a	**198.80 A**
Mean **	**150.90 B**	**182.80 A**		**164.60 B**	**188.50 A**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.3.5. Leaf iron content:

- **Specific effect:**

With regard to specific effect of orange cultivars, **Table (12)** shows that, Jaffa orange cultivar had leaves higher Fe content rather than Hamlin orange cultivar during two succissive seasons.

As for the response to specific effect of growth regulators treatments, it was clear that, CPPU at 20 ppm + GA_3 at 100 or 200 ppm gave the high values compared with the other treatments during two seasons of study.

- **Interaction effect:**

Concerning the interaction effect varions combinations between orange cultivars and growth regulators treatments on leaf Fe content it was interesting to be noticed that, the richest leaves in their Fe content were inclosed relationship to Jaffa orange cultivar treated with CPPU at 20 ppm + GA_3 at 100 or 200 ppm, while the reverse was found with leaves of the Hamlin orange cultivar treated with tap water (control) during two seasons of study.

These results are in line with those obtained by **Souza (2000)** and **Abd El- Rahman (2003).**

Table (12):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on leaf iron (ppm) content of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	28.67 i	40.67 h	**34.67 F**	31.67 g	44.33 ef	**38.00 H**
CPPU at 10 ppm	39.67 h	5267 efg	**36.14 E**	49.33 de	60.33 c	**54.83 G**
CPPU at 20 ppm	47.67 g	56.33 e	**52.00 D**	60.67 c	69.33 b	**65.00 D**
GA_3 at 100 ppm	38.67 h	74.00 b	**56.33 C**	39.67 f	78.33 a	**59.00 EF**
GA_3 at 200 ppm	40.33 h	65.67 cd	**53.00 CD**	52.67 d	61.00 c	**56.83 FG**
CPPU at 10 ppm + GA_3 at 100 ppm	49.33 fg	61.67 d	**55.50 CD**	59.33 c	63.00 c	**61.17 E**
CPPU at 10 ppm + GA_3 at 200 ppm	54.00 ef	72.67 b	**63.33 B**	63.33 c	78.33 a	**70.83 C**
CPPU at 20 ppm + GA_3 at 100 ppm	70.67 bc	80.67 a	**75.67 A**	71.33 b	79.67 a	**75.50 B**
CPPU at 20 ppm + GA_3 at 200 ppm	70.33 bc	80.67 a	**75.50 A**	77.33 a	81.67 a	**79.50 A**
Mean **	**48.81 B**	**65.00 A**		**56.15 B**	**68.44 A**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.3.6. Leaf manganase content:

- **Specific effect:**

Reffering the specific effect of orange cultivars, **Table (13)** shows that, leaf Mn content was higher in Jaffa orange cultivar during two seasons of study.

As for the response to specific effect of growth regulators. It was clear an increase was observed in leaves of CPPU at 20 ppm + GA_3 at 200 ppm during the first season only. Moreover, the increase was observed in leaves of GA_3 at 200 ppm or CPPU at 10 ppm + GA_3 at 200 ppm during the second season.

- **Interaction effect:**

Table (13) reveald that, interaction effect of various combinations between two investigated factors (orange cultivars X growth regulators) was coincided to with their specific effect. Herein, the highest value of leaves manganase content was markedly coupled with Jaffa orange cultivar treated with CPPU at 20 ppm + GA_3 at 200 ppm, but the reverse was found with those in Hamlin or Jaffa orange cvs. treated with tap water (control). Such trend was true during both 2002 and 2003 seasons.

These results are in line with those obtained by **Abd El-Rahman (2003).**

Table (13):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on leaf manganase (ppm) content of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	0.29 i	0.35 gh	**0.32 E**	0.33 l	0.31 l	**0.32 F**
CPPU at 10 ppm	0.41 f	0.40 fg	**0.41 D**	0.50 gh	0.46 ij	**0.48 E**
CPPU at 20 ppm	0.31 hi	0.65 b	**0.48 C**	0.41 k	0.62 d	**0.51 D**
GA_3 at 100 ppm	0.63 b	0.51 de	**0.57 B**	0.53 fg	0.58 e	**0.56 C**
GA_3 at 200 ppm	0.42 f	0.56 cd	**0.49 C**	0.70 b	0.66 c	**0.68 A**
CPPU at 10 ppm + GA_3 at 100 ppm	0.60 bc	0.52 de	**0.56 B**	0.47 hij	0.55 ef	**0.51 D**
CPPU at 10 ppm + GA_3 at 200 ppm	0.51 de	0.63 b	**0.57 B**	0.69 bc	0.67 bc	**0.68 A**
CPPU at 20 ppm + GA_3 at 100 ppm	0.48 e	0.48 e	**0.48 C**	0.45 j	0.50 ghi	**0.47 E**
CPPU at 20 ppm + GA_3 at 200 ppm	0.64 b	0.71 a	**0.68 A**	0.51 g	0.73 a	**0.62 B**
Mean **	**0.48 B**	**0.53 A**		**0.51 B**	**0.57 A**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.4. Yield indicators:

IV.4.1. Fruit set percentage:

- **Specific effect:**

Regarding the specific effect of orange cultivars on fruit set%, **Table (14)** display obviously that, differences were so slight to level of significance during first season between Hamlin and Jaffa cultivars. Moreover, in the second season fruit set percentage of Hamlin orange cultivar higher than Jaffa orange cultivar.

As for the response to specific effect of growth regulators treatments, it was clear that, an increase was observed fruit set of CPPU at 10 ppm + GA_3 at 200 ppm treatments during two seasons of study.

- **Interaction effect;**

Table (14) reveald that irteraction effect of various combinations between two investigated factors (orange cultivars X growth regulators) was coincided to with their specific effect. Herien, the hight value of fruit set% was markedly coupled with Jaffa orange cultivar treated with CPPU at 10 ppm + GA_3 at 200 ppm in the first season. But, in the second season the reverse was found with those in Hamlin orange cultivar treated with CPPU at 20 ppm + GA_3 at 200 ppm.

These results are in line with those obtained by **Franciosi and Ponce (1970)** on washington navel orange; **Deidda (1971); Roy (1973); Canat *et al.*, (1974); Chundawat and Randhawa (1976); Atawia (1984); Kouka (1987); Lue *et al.*, (1992); Smith (1992); Abd ul *et al.*, (1998) and Faeng *et al.*, (1999).**

Table (14):Effect of Sitofex (CPPU) and gibberellic acid ($GA_{3)}$ applications on fruit set percentage of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	10.43 J	12.09 i j	**11.26 F**	12.75i j	10.90 j	**11.82 E**
CPPU at 10 ppm	18.15 ef	15.45 h	**16.98 E**	22.46 c	13.28 hi	**17.87 C**
CPPU at 20 ppm	18.00 efg	17.30 fgh	**17.65 E**	19.98 d	15.39 fgh	**17.66 C**
GA_3 at 100 ppm	12.73 I	12.67 ij	**12.65 F**	14.00 ghi	11.79 ij	**12.90 E**
GA_3 at 200 ppm	15.88 gh	19.81 de	**17.85 DE**	15.63 fg	15.70 fg	**15.66 D**
CPPU at 10 ppm + GA_3 at 100 ppm	16.45 fgh	22.10d	**19.28 D**	18.01 de	19.75 d	**18.88 C**
CPPU at 10 ppm + GA_3 at 200 ppm	27.95 c	34.83 a	**31.39 A**	24.89 b	24.44 bc	**24.66 A**
CPPU at 20 ppm + GA_3 at 100 ppm	20.79 d	21.24 d	**21.01 C**	22.37 c	19.66 d	**21.01 B**
CPPU at 20 ppm + GA_3 at 200 ppm	30.88 b	17.34 fgh	**24.11 B**	29.77 a	16.76 ef	**23.27 A**
Mean **	**19.07 A**	**19.19 A**		**19.99 A**	**16.41 B**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV. 4.2. Remained friuts percentage:

- **Specific effect:**

Concerning the response of remained fruits percentage to specific effect of orange cultivars, it is quite clear as shown from tabulated data in **Table (15)** that, Hamlin orange cultivar gave high values compared with Jaffa orange cultivar in this respect during both seasons of study.

As for specific effect of growth regulators, **Table (15)** show that, CPPU at 10 ppm + GA_3 at 200 ppm show treatment resulted on significant increase over the other treatments during experimental seasons.

- **Interaction effect:**

Table (15) shows that, the specific effect of each investigated factor was directly reflected on interaction effect of their combinations, whereas considerable changes in response of two orange cultivars could easy observed as compared with other in this respect.

Nevertheless, with Hamlin orange cultivar treated with CPPU at 20 ppm + GA_3 at 200 ppm as either Jaffa orange cultivar or Hamlin orange cultivar treated with other treatments exhibited statistically the high remained fruits percentage. Such trend was truse during both seasons in the study.

These results are in agreement with those obtained by. **Randhawa & Sharma (1962); Ranhhawa & Dhuria (1965), Chundwat & Randhawa (1976); Joshi *et al.*, (1977); Gallasch (1978); Kouka (1987) and Panwar *et al.*, (1994-b).**

Table (15):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on remained fruits percentage after june drop of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	8.36 k	6.90 m	**7.63 h**	9.79 j	6.38 e	**8.08 H**
CPPU at 10 ppm	12.69 f	8.68 jk	**10.68 e**	12.47 f	9.80 j	**11.14 F**
CPPU at 20 ppm	10.80 hi	9.36 j	**10.07 F**	10.50 i	11.53 h	**11.01 F**
GA_3 at 100 ppm	10.12 i	7.63 e	**8.88 G**	11.14 h	8.95 k	**10.04 G**
GA_3 at 200 ppm	11.36 gh	10.35 i	**10.86 E**	11.93 g	11.28 h	**11.61 E**
CPPU at 10 ppm + GA_3 at 100 ppm	12.64 f	14.33 e	**13.59 D**	12.81 f	14.19 e	**13.50 D**
CPPU at 10 ppm + GA_3 at 200 ppm	16.58 d	20.63 b	**20.82 A**	18.45 b	19.31 a	**18.88 A**
CPPU at 20 ppm + GA_3 at 100 ppm	10.04 e	19.73 c	**16.89 B**	16.34 d	17.15 c	**16.75 B**
CPPU at 20 ppm + GA_3 at 200 ppm	25.07 a	11.77 g	**16.22 C**	19.41 a	12.50 f	**15.95 C**
Mean **	**13.05 A**	**12.65 B**		**13.65 A**	**12.34 B**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.4.3. Yield Percentage:

- **Specific effect:**

Table (16) shows clearly that, yield % of Hamlin and Jaffa orange cultivars was significantly influenced by specific effect of both investigated factors i.e. orange cultivars and growth regulator treatments. Herein, Hamlin orange cultivar showed statistically higher yield percentage than Jaffa orange cultivar during both seasons of study.

As for the specific effect of growth regulators treatments, it was quite evident that, CPPU at 10 ppm + GA_3 at 200 ppm treatment gave the high values in this respect during 2002 and 2003 seasons.

- **Interaction effect:**

Table (16) displays obviously that, specific effect of each investigated factor was directly reflected on their various combinations. In the other words, Jaffa orange cultivar treating with CPPU at 10 ppm + GA_3 at 200 ppm gave high yield percentage. Such trend was true during 2002 and 2003 experimental seasons.

These results are in line with, **Ashkenzay *et al.*, (1971); El-Khoreiby (1976); El-Hammady *et al.*, (1976); Blondal (1976); Gallasch (1978); Rabe *et al.*, (1993) and Liu *et al.*, (1999).**

Table (16):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on yield percetage of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	6.28 jk	4.91 e	**5.60 H**	6.67 j	3.57 k	**5.12 F**
CPPU at 10 ppm	10.58 def	6.47 jk	**8.52 F**	8.84 gh	7.50 i	**8.18 E**
CPPU at 20 ppm	9.34 gh	8.40 i	**8.87 EF**	9.01 fgh	8.76 gh	**8.89 D**
GA_3 at 100 ppm	7.07 j	5.79 kl	**6.43 G**	9.73 def	6.75 j	**8.24 E**
GA_3 at 200 ppm	10.22 efg	8.55 hi	**9.39 E**	9.85 de	8.35 h	**9.10 D**
CPPU at 10 ppm + GA_3 at 100 ppm	11.13 de	11.26 d	**11.20 D**	10.48 d	10.53 d	**10.51 C**
CPPU at 10 ppm + GA_3 at 200 ppm	13.38 c	18.72 a	**16.05 A**	13.45 b	14.27 a	**13.86 A**
CPPU at 20 ppm + GA_3 at 100 ppm	11.13 de	13.51 c	**12.32 C**	11.99 c	11.47 c	**11.73 B**
CPPU at 20 ppm + GA_3 at 200 ppm	16.33 b	9.80 fg	**13.07 B**	14.50 a	9.49 efg	**11.99 B**
Mean **	**10.61 A**	**9.71 B**		**10.50 A**	**8.97 B**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.5. Fruit charactaristics:

IV.5.1. Fruit weight:

- **Specific effect:**

Referring the specific effect of orange cultivar on fruit weight tabulated data in **Table (17)** display that the heaviest friut was statisticaly exhibited by Hamlin orange cultivar during two seasons of study. Moreover, the specific effect of growth regulators was obviously that, CPPU at 10 ppm + GA_3 at 200 ppm treatment gave the heaviest fruits compared with the other treatments during both seasons of study.

- **Interaction effect:**

Table (17) shows obviously that, the heaviest fruits were obtained from Hamlin orange cultivar treated with CPPU at 10 ppm + GA_3 at 200 ppm treatment, but the revers was true with the Jaffa orang cultivar when treated with tap water (control), the other treatments gave values between them. Such trend was true during both seasons.

These results go in line with those obtained by **Atawia (1984); Atawia (1988); Chu *et al.*, (1998); Retmales *et al.*, (1998); Xu *et al.*, (1998); Cruz *et al.*, (1999); Luo *et al.*, (1999)** and **Gao (1999).**

Table (17):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on fruit weight (gm) of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	171.50 efg	164.30 h	**167.90 C**	177.10 efg	169.10 i	**173.10 E**
CPPU at 10 ppm	181.20 bc	174.40 de	**177.80 AB**	178.30 def	174.20 gh	**176.20 D**
CPPU at 20 ppm	182.40 ab	177.30 cd	**179.90 A**	179.90cde	176.70 efg	**178.30 CD**
GA_3 at 100 ppm	182.00 bc	167.20 gh	**174.60 B**	182.30bc	174.10 gh	**178.20 CD**
GA_3 at 200 ppm	181.50 bc	169.10 fg	**175.30 AB**	181.50 bcd	171.50 hi	**176.50 D**
CPPU at 10 ppm + GA_3 at 100 ppm	185.90 ab	171.40 efg	**178.60 AB**	184.10 b	174.70 fgh	**179.40 BC**
CPPU at 10 ppm + GA_3 at 200 ppm	187.20 a	172.10 ef	**179.70 A**	187.40 a	182.50 bc	**184.90 A**
CPPU at 20 ppm + GA_3 at 100 ppm	184.10 ab	173.70 def	**178.90 AB**	182.50 bc	180 cde	**181.20 B**
CPPU at 20 ppm + GA_3 at 200 ppm	175.60 de	177.10 cd	**176.40 AB**	181.50 bcd	181.10 bcd	**181.30 B**
Mean **	**181.30 A**	**171.90 B**		**181.60 A**	**176.00 B**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.5.2. Fruit size:

- **Specific effect**

Table (18) shows that the fruit size of orange cultivars followed generally the same trends previously discussed with fruit weight regarding the specific effect of each factor. However, differences were high pronounced in fruit size, whereas variance in most cases reach level of significance during two seasons of study.

- **Interaction effect:**

Referring the response of fruit size to interaction effect of orange cultivars x growth regulators combinations, **Table (18)** shows obviosly that, the highest value was significantly recorded by fruits of Hamlin orange cultivar when treated with CPPU at 10 ppm + GA_3 at 100 or 200 ppm during two seasons of study.

The obtained data are in agreement with findings of **Damigella *et al.*, (1970); Mazumdr & Bhatt (1977); Mawlood (1977); Lang *et al.*, (1982); Atawia (1988); Henzell *et al.*, (1992); Liu *et al.*, (1999) and Leao *et al.*, (1999).**

Table (18):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on fruit volume (cm^3) of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	180.90 e	164.50 i	**172.70 F**	185.80 e	171.30 k	**178.50 D**
CPPU at 10 ppm	187.60 bcd	173.10 g	**180.30 CD**	188.20 d	174.00 ij	**181.10 C**
CPPU at 20 ppm	188.90 b	172.40 gh	**180.70 BCD**	191.70 b	177.60 h	**184.60 B**
GA_3 at 100 ppm	188.20 cd	164.40 i	**175.30 E**	188.90 cd	175.90 hi	**182.40 C**
GA_3 at 200 ppm	188.70 bc	170.00 h	**179.40 D**	191.80 b	172.80 jk	**182.20 C**
CPPU at 10 ppm + GA_3 at 100 ppm	191.90 a	173.00 g	**182.40 B**	190.80 bc	180.70 g	**185.70 B**
CPPU at 10 ppm + GA_3 at 200 ppm	191.30 a	170.80 gh	**180.90 BCD**	195.40 a	180.10 g	**187.80 A**
CPPU at 20 ppm + GA_3 at 100 ppm	188.50 bc	175.50 f	**182.0 BC**	191.60 b	180.40 g	**188.10 B**
CPPU at 20 ppm + GA_3 at 200 ppm	185.00 d	186.80 bcd	**185.90 A**	192.40 b	182.90 f	**187.70 A**
Mean **	**187.70 A**	**172.30 B**		**190.70 A**	**177.30 B**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.5.3. Fruit length:

- **Specific effect:**

As for the specific effect of orange cultivars, **Table (19)** displays that, the fruit length was longest in Hamlin cultivar rather than in Jaffa orange cultivar during two seasons. Meanwhile, the response to specific effect of growth regulators was obviously noticed, whereas GA_3 at 200 ppm surpassed statistically other treatments during two seasons of study in this respect.

- **Interaction effect:**

Regarding the interaction effect of various (orange cultivars x growth regulators) combinations, **Table (19)** reveals that, Hamlin orange cultivar treating with CPPU at 20 ppm + GA_3 at 200 ppm had significantly the tallest (longest) fruits. Meanwhile, the reverse was true with Jaffa orange cultivar x tap water (control). In addition, other combinations were in between them during two seasons.

The obtained results are in confirm with **El-Khoreiby (1976); Atawia (1984); Sotomayor (1996); Xu *et al.*, (1998)** and **Rao *et al.*, (1999).**

Table (19):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on fruit length(cm.) of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	6.80 hi	6.37 j	**6.58 D**	6.97 ij	6.89 jk	**6.93 D**
CPPU at 10 ppm	6.78 hi	6.37 j	**6.57 D**	6.80 jk	6.70 k	**6.75 E**
CPPU at 20 ppm	6.65 i	6.31 j	**6.48 D**	7.32 efg	6.89 jk	**7.11 C**
GA_3 at 100 ppm	7.36 bc	6.91 gh	**7.13 C**	7.64 abc	7.19 gh	**7.42 B**
GA_3 at 200 ppm	7.53 ab	7.30 cd	**7.44 A**	7.61 bcd	7.80 ab	**7.70 A**
CPPU at 10 ppm + GA_3 at 100 ppm	7.28 cd	7.07 efg	**7.18 BC**	7.42 def	7.40 defg	**7.41 B**
CPPU at 10 ppm + GA_3 at 200 ppm	7.25 cde	7.10 defg	**7.18 BC**	7.29 fgh	7.30 fgh	**7.29 B**
CPPU at 20 ppm + GA_3 at 100 ppm	7.21 cdef	7.01 fg	**7.11 C**	7.53 cde	7.10 hi	**7.32 B**
CPPU at 20 ppm + GA_3 at 200 ppm	7.58 a	7.07 efg	**7.30 B**	7.83 a	7.52 cde	**7.68 A**
Mean **	**7.16 A**	**6.83 B**		**7.38 A**	**7.20 B**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.5.4. Fruit diameter:

- **Specific effect:**

Data obtained during both seasons as shown in **Table (20)** cleared that, however the same trends of rsponse regarding the specific effect of both (orange cultivars and growth regulators) previously discused with the fruit length were also detected for fruit diameter, but differences did not reach level of significance especially the effect of growth regulators during the first season.

- **Interaction effect:**

It was so clear that, the response of fruit diameter to the differenetial investigated combinations between two investigated factors (orange cultivars X growth regulators) followed generally the trend previously detected with fruit length. However, differences in most cases it is reach level of significance, such trend was true during both seasons of study.

A similar result was also obtained by **El-Khoriby (1976); Atawia (1984) and Xu *et al.*, (1998).**

Table (20):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on fruit diameter (cm.) of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	6.99 b	5.94 d	**6.47 B**	7.01 efg	6.83 i	**6.96 D**
CPPU at 10 ppm	7.94 a	6.17 cd	**7.06 A**	7.32 bcd	6.89 hi	**7.11 CD**
CPPU at 20 ppm	7.93 a	6.43 c	**7.18 A**	7.86 a	7.14 efg	**7.50 A**
GA_3 at 100 ppm	7.17 b	6.13 cd	**6.65 B**	7.05 fg	7.09 efg	**7.07 CD**
GA_3 at 200 ppm	7.17 b	6.98 b	**7.08 A**	7.01 gh	7.12 efg	**7.07 CD**
CPPU at 10 ppm + GA_3 at 100 ppm	6.98 b	6.98 b	**6.97 A**	7.17 def	7.33 bc	**7.25 BC**
CPPU at 10 ppm + GA_3 at 200 ppm	6.95 b	7.00 b	**6.97 A**	7.43 b	7.24 cde	**7.33 AB**
CPPU at 20 ppm + GA_3 at 100 ppm	7.07 b	7.03 b	**7.05 A**	7.80 a	6.99 gh	**7.40 AB**
CPPU at 20 ppm + GA_3 at 200 ppm	7.30 b	7.14 b	**7.22 A**	7.30 bcd	7.35 bc	**7.32 AB**
Mean **	**7.27 A**	**6.65 B**		**7.34 A**	**7.11 B**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV. 5.5. Fruit shape index:

- **Specific effect:**

Concerning the response of fruit shape index to specific effect of orange cultivars, **Table (21)** shows that, fruits produced from Jaffa orange cultivar gave the high values in this respect during the first season but, no differences between two cultivars during the second season. Meanwhile, the response to specific effect of growth regulators was more pronounced, whereas GA_3 at 200 ppm treatment had significantly higher values than the other treatments during both seasons of study.

- **Interaction effect:**

Table (21) shows obviously that, both orange cultivars varied greatly in their response to interaction effect of orange cultivars X growth regulators, whereas each treatment followed Anyhow, GA_3 at ppm + Jaffa or Hamlin orange cultivars showed the largest values, while the reverse was true with tap water (control).

The obtained data is in partial agreement with that obtained by **Mawlood (1977); Hussain (1979); Babu & Lavania (1985)** and **Rao *et al.*, (1999).**

Table (21):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on fruit shape index (L/D) of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	0.66 d	1.07 a	**0.87 C**	0.98 cd	1.04 abc	**1.01 B**
CPPU at 10 ppm	0.85 bc	1.03 ab	**0.94 ABC**	0.93 d	0.97 cd	**0.95 C**
CPPU at 20 ppm	0.84 c	0.98 abc	**0.91 BC**	0.93 d	0.97 cd	**0.95 C**
GA_3 at 100 ppm	1.02 abc	1.11a	**1.07 A**	1.08 ab	1.02 c	**1.05 AB**
GA_3 at 200 ppm	1.06 a	1.04 a	**1.05 A**	1.09 a	1.10 a	**1.09 A**
CPPU at 10 ppm + GA_3 at 100 ppm	1.00 abc	1.01 abc	**1.00 AB**	1.03 abc	1.01 c	**1.02 B**
CPPU at 10 ppm + GA_3 at 200 ppm	1.10 a	1.01 abc	**1.0 b A**	0.98 cd	1.01 c	**0.99 BC**
CPPU at 20 ppm + GA_3 at 100 ppm	1.02 abc	0.99 abc	**1.01 AB**	1.00 c	1.02 c	**1.01 B**
CPPU at 20 ppm + GA_3 at 200 ppm	1.03 ab	0.98 abc	**1.01 AB**	1.03 abc	1.02 c	**1.03 B**
Mean **	**0.95 B**	**1.03 A**		**1.01 A**	**1.02 A**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV. 5.6. Fruit peel thickness:

- **Specific effect:**

Data obtained during both seasons in **Table (22)** cleared that, however the same trends of response regarding the specific effect of both (orange cultivars & growth regulators) previously discussed with the most measurements were also detected for fruit peel thickness.

As for specific effect of orange cultivars it is evident quite that Jaffa orange cultivar had higher of fruit peel thickness than Hamlin cultivar during both seasons of study. Regarding the response of fruit peel thickness to growth regulators treatments, it is quite evident that, the response was more pronounced than that previously discussed with orange cultivars. Wherease, the fruit peel thickness was large when used GA_3 at 100 or 200 ppm during two seasons of study.

- **Interaction effect:**

It was so clear that, the response of fruit peel thickness to the differential investigated combinations between two investigated factors (orange cultivars X growth regulators) followed generally the same trend previously detected with fruit shape index. However, differences in most cases didn't reach level of significance except when the superios combination

(Jaffa orange X CPPU at 20 ppm + GA_3 at 200 ppm) during two seasons of study.

A similar result was also obtained by **El-Khoreiby (1976); Chundawat & Randhawa (1976); Goldschmidit *et al.*, (1988) And Atawia (1988).**

Table (22):Effect of Sitofex (CPPU) and gibberellic acid ($GA_{3)}$ applications on fruit peel thikness (cm.) of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	0.34 e	0.60 abc	**0.47 B**	0.39 f	0.51 cde	**0.46 D**
CPPU at 10 ppm	0.41 de	0.67 ab	**0.54 AB**	0.50 cde	0.58 bc	**0.54 C**
CPPU at 20 ppm	0.46 cde	0.71 a	**0.59 A**	0.52 cde	0.71 a	**0.62 AB**
GA_3 at 100 ppm	0.55 bcd	0.72 a	**0.64 A**	0.52 cde	0.73 a	**0.63 AB**
GA_3 at 200 ppm	0.47 cde	0.72 a	**0.60 A**	0.56 cd	0.72 a	**0.64 A**
CPPU at 10 ppm + GA_3 at 100 ppm	0.41 de	0.70 a	**0.56 AB**	0.47 ef	0.70 a	**0.59 ABC**
CPPU at 10 ppm + GA_3 at 200 ppm	0.42 de	0.66 ab	**0.54 AB**	0.48 de	0.66 ab	**0.57 BC**
CPPU at 20 ppm + GA_3 at 100 ppm	0.40 e	0.70 a	**0.55 AB**	0.55 cd	0.70 a	**0.63 AB**
CPPU at 20 ppm + GA_3 at 200 ppm	0.45 de	0.72 a	**0.59 A**	0.47 de	0.73 a	**0.60 AB**
Mean **	**0.44 B**	**0.69 A**		**0.50 B**	**0.67 A**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

I.V. 5.7. Total souluble solids percentage:

- **Specific effect:**

Concerning the specific effect of orange cultivars, **Table (23)** shows obviously that the T.S.S content in fruits of two orange cultivars followed a firm trend during both seasons. Herein, the highest level was always in significant concomitant to fruits of both orange cultivars during two seasons of study.

Nevertheless, the specific effect of growth regulators followed two opposite trends with two orange cultivars as their fruit T.S.S. contents were concerned. Herein, with CPPU at 10 or 20 ppm treatments the highest fruits T. S.S. content was significantly link during both seasons of study.

- **Interaction effect:**

The trend of response to interaction effect with fruit T.S.S. content of orange cultivars were the same during both seasons. Hence, the highest fruit T.S.S. content was in closed relationship to those Jaffa orange cultivar treated with CPPU at 20 ppm during two seasons of study. On the contrary, the least T.S.S. level was observed in fruits of Jaffa or Hamlin orange treated with GA_3 at 20 ppm during 2002 and 2003 seasons.

These results are in line with those obtained by **Lotter (1992); Reynolds *et al.*, (1992); patterson *et al.*, (1993); and Cai *et al.*, (1996).**

Table (23):Effect of Sitofex (CPPU) and gibberellic acid ($GA_{3)}$ applications on T.S.S percentage of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	11.30 cd	10.39 f	**10.58 C**	10.60 fg	10.80 ef	**10.70 D**
CPPU at 10 ppm	12.40 a	12.34 a	**12.41 A**	12.41 b	11.60 c	**12.20 B**
CPPU at 20 ppm	12.47 a	12.60 a	**12.53 A**	12.70 ab	12.81 a	**12.55 A**
GA_3 at 100 ppm	10.90 de	9.80 g	**10.35 D**	10.20 h	11.07 de	**10.64 D**
GA_3 at 200 ppm	10.60 ef	10.20 fg	**10.40 D**	10.40 gh	10.61 fg	**10.50 D**
CPPU at 10 ppm + GA_3 at 100 ppm	11.79 b	11.60 bc	**11.69 B**	11.20 de	10.91 ef	**11.05 C**
CPPU at 10 ppm + GA_3 at 200 ppm	11.40 bc	11.49 bc	**11.44 B**	10.90 ef	11.41 cd	**11.15 C**
CPPU at 20 ppm + GA_3 at 100 ppm	11.60 bc	10.61 ef	**11.10 C**	10.90 ef	11.60 c	**11.25 C**
CPPU at 20 ppm + GA_3 at 200 ppm	11.81 b	10.41 f	**11.11 C**	11.60 c	10.80 ef	**11.20 C**
Mean **	**11.59 A**	**11.06 B**		**11.26 A**	**11.24 A**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.5.8. Acidity percentage:

- **Specific effect:**

Concerning the specific effect of orange cultivars on fruit acidity content, **Table (24)** shows that, fruits of Jaffa orange cultivar contained lower values from acidity compared with Hamlin orange cultivar during the first season. The reverse was true during the second season.

With regard to specific effect of growth regulators, it was quite evident that, variances were so little to be taken into consideration. However, very slight tendency of increase could be observed in fruits of orange cultivars treated with GA_3 at 20 ppm during both seasons of study.

- **Interaction effect;**

Data obtained during both seasons revealed that, the highest fruits acidity content was usually concomitant to Jaffa orange cultivar treated with GA_3 at 20 ppm during both seasons of study.

On the contrary, the least fruit content varied from combination to another, whereas Hamlin orange cultiuvar treated with CPPU at 20 ppm + GA_3 at 200 ppm gave the lowest values in this respect. In addition, other combinations were in between them aforesaid two extermes during two seasons of study.

These results are in line with those obtained by **El-Khoreiby (1976); Mazumdar & Bhatt (1977); Mawlood (1977); Atawia (1984); Kim (1991)** and **Panwer *et al.*, (1994-b).**

Table (24):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on acidity percentage of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	1.42 fg	1.41 g	**1.41 D**	1.22 f	1.32 e	**1.27 D**
CPPU at 10 ppm	1.21 h	1.16 i	**1.18 E**	1.00 j	1.12 i	**1.06 G**
CPPU at 20 ppm	1.19 h	1.07 e	**1.13 F**	1.02 j	1.13 i	**1.07 F**
GA_3 at 100 ppm	1.52 c	1.49 d	**1.51 B**	1.45 c	1.52 b	**1.49 B**
GA_3 at 200 ppm	1.56 b	1.58 a	**1.57 A**	1.51 b	1.55 a	**1.53 A**
CPPU at 10 ppm + GA_3 at 100 ppm	1.43 f	1.50 d	**1.46 C**	1.19 g	1.36 d	**1.28 D**
CPPU at 10 ppm + GA_3 at 200 ppm	1.46 e	1.49 d	**1.47 C**	1.23 f	1.47 c	**1.35 C**
CPPU at 20 ppm + GA_3 at 100 ppm	1.19 h	1.16 i	**1.18 E**	1.18 h	1.12 i	**1.14 E**
CPPU at 20 ppm + GA_3 at 200 ppm	1.11 k	1.14 j	**1.13 F**	1.00 j	1.15 h	**1.08 F**
Mean **	**1.34 A**	**1.33 B**		1.19 B	1.31 A	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.5.9. Tatal soluble solid /Acidity:

- **Specific effect:**

Referring the specific effect of orange cultivars of T.S.S./acidity content of orange fruits, **Table (25)** show that, however an increase was generally observed in Hamlin orange cultivars during two seasons.

As for the specific effect of growth regulators, it was quite evident that, variations in most cases were too slight to reach level of significance, especially with GA_3 at 200ppm and CPPU at 20 ppm, respectively. Such trend was true during both seasons of study.

- **Interaction effect:**

Data obtained during both seasons revealed obviously the specific effect of each investigated factor was directly reflected on the interaction effects of investigated combinations between two factors under study. Herein, the highest values from T.SS / acidity were obtained from Jaffa orange cultivar treated with CPPU at 20 ppm during first season. On the contrary, during second seasons Hamlin orange cultivar treating with CPPU at 10 or 20 ppm gave the highest values in this respect.

These results are parallel to those of **Hussain (1979); Lotter (1992)** and **Patterson *et al.*, (1993).**

Table (25):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) applications on T.S.S / acidity of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	7.95 fg	7.39 ij	**7.67 E**	8.71 f	8.16 g	**8.44 DE**
CPPU at 10 ppm	10.27 c	10.71 b	**10.49 B**	12.81 a	10.39 d	**11.60 A**
CPPU at 20 ppm	10.49 bc	11.79 a	**11.14 A**	12.49 a	11.02 c	**11.75 A**
GA_3 at 100 ppm	7.17 jk	6.58 e	**6.87 F**	7.02 i	7.26 hi	**7.14 F**
GA_3 at 200 ppm	6.81 kl	6.45 e	**6.63 F**	6.88 i	6.84 i	**6.86 F**
CPPU at 10 ppm + GA_3 at 100 ppm	8.27 f	7.53 hij	**7.89 E**	9.39 e	8.02 g	**8.71 D**
CPPU at 10 ppm + GA_3 at 200 ppm	7.84 gh	7.43 ghi	**7.79 E**	8.89 ef	7.76 gh	**8.32 E**
CPPU at 20 ppm + GA_3 at 100 ppm	9.70 d	9.15 e	**9.43 D**	9.40 e	10.33 d	**9.87 C**
CPPU at 20 ppm + GA_3 at 200 ppm	10.63 bc	9.13 e	**9.88 C**	11.56 b	9.39 e	**10.48 B**
Mean **	**8.79 A**	**8.49 B**		**9.68 A**	**8.80 B**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV. 5.10. Ascorbic acid content (Vitamin C):

- **Specific effect:**

With regard to specific effect of orange cultivars, **Table (26)** revealed that, fruit vitamin C content of two orange cultivars response significantly during two seasons of study. Meanwhile, the specific effect of growth regulators on vitamin C content, it was quite evident that, the highest values in this respect were obtained from CPPU at 10 ppm + GA_3 at 100 ppm during first season. In the second season, CPPU at 20 ppm + GA_3 at 100 ppm treatment gave the highest values in this respect.

- **Interaction effect:**

Data obtained from Table (26) revealed that the response of fruit vitamin C content to interaction effect had on similar trend which not only from one orange cultivars to another but also varied greatly for same orange cultivars during two seasons, especially Hamlin orange cultivar. On the other hand, Jaffa orange cultivar treated with tap water gave the lowest values in this respect during two successive seasons. These results are go in line with those obtained by **Cutuli (1970); Kumar *et al.*, (1975); Chundwat & Rabdhawa (1976); Mawlood (1977); Atawia (1984);** and **Izumi *et al.*, (1988).**

Table (26):Effect of Sitofex (CPPU) and gibberellic acid ($GA_{3)}$ applications on vitamine C of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	52.09 bc	48.00 cd	**50.35 C**	50.46 efgh	45.55 h	**48.00 E**
CPPU at 10 ppm	56.20 ab	47.33 cd	**51.77 BC**	54.79 cde	49.22 fgh	**52.01 CD**
CPPU at 20 ppm	56.71 a	48.41 cd	**52.66 ABC**	56.44 cd	50.95 efgh	**53.69 BC**
GA_3 at 100 ppm	58.94 a	47.03 d	**52.99 ABC**	55.52 cde	51.48 defg	**53.20 BC**
GA_3 at 200 ppm	60.43 a	49.96 cd	**55.20 A**	56.77 c	47.31 gh	**52.04 CD**
CPPU at 10 ppm + GA_3 at 100 ppm	60.32 a	50.64 cd	**55.46 A**	49.00 fgh	49.05 fgh	**49.02 DE**
CPPU at 10 ppm + GA_3 at 200 ppm	58.89 a	47.38 cd	**53.14 ABC**	62.19 b	50.12 efgh	**56.15 AB**
CPPU at 20 ppm + GA_3 at 100 ppm	57.48 a	48.82 cd	**53.15 ABC**	67.40 a	50.60 efgh	**59.00 A**
CPPU at 20 ppm + GA_3 at 200 ppm	57.12 a	52.16 bc	**54.64 AB**	54.17 cdef	50.47 efgh	**52.32 CD**
Mean **	**57.58 A**	**48.93 B**		**56.30 A**	**49.42 B**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.6. Seedliness and seed development:

IV.6.1. Effect of growth regulators on number of seeds / fruit:

- **Specific effect:-**

Data presented in **Table (27)** show clearly that number of seeds per fruit of Hamlin and Jaffa orange cultivars was significantly influenced by specific effect of both investigated factors i.e., growth regulators and cultivars. Heriein, CPPU at 10 or 20 ppm showed statistically lower seeds per fruit than other treatments during both experimental 2002 and 2003 seasons. As for the specific effect of cultivars, it was quite evident that, Hamlin cultivar surpassed statistically Jaffa cultivar ones in this respect.

- **Interaction effect:**

Table (27) displays obviously that, specific effect of each investigated factor was directly reflected on their various combination. In the other words, treatment with CPPU at 10 ppm + GA_3 at 200 ppm of Hamlin and Jaffa cultivars were significantly highest than the other interactions. Such trend was true during both 2002 and 2003 experimental seasons.

Table (27):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) application on No. of seeds / fruit of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	10.62 a	4.96 c	**7.79 A**	9.03 a	3.60 e	**6.05 A**
CPPU at 10 ppm	8.93 b	3.84 cd	**6.39 B**	6.22 d	2.66 e	**4.44 B**
CPPU at 20 ppm	8.60 b	3.96 cd	**6.28 B**	6.14 d	2.71 e	**4.43 B**
GA_3 at 100 ppm	9.10 b	3.54 d	**6.32 B**	7.20 bc	2.56 e	**4.88 B**
GA_3 at 200 ppm	9.12 b	3.98 cd	**6.55 B**	7.35 b	2.89 e	**5.12 B**
CPPU at 10 ppm + GA at 100 ppm	7.93 b	3.76 d	**5.85 B**	6.12 d	2.54 e	**4.33 B**
CPPU at 10 ppm + GA at 200 ppm	8.00 b	3.80 d	**5.90 B**	6.29 cd	2.28 e	**4.28 B**
CPPU at 20 ppm + GA at 100 ppm	8.55 b	3.71 d	**6.13 B**	6.36 cd	2.52 e	**4.44 B**
CPPU at 20 ppm + GA at 200 ppm	8.16 b	3.96 d	**5.93 B**	6.10 d	2.48 e	**4.29 B**
Mean **	**8.78 A**	**3.92 B**		**6.76 A**	**2.63 B**	

- and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.6.2. Effect of growth regulators on number and % of well developed seeds per fruit:

- **Specific effect:**

As for the specific effect of growth regulators, **Tables (28 & 29)** displays that, the percentage and number of developed seeds per fruit was highest when treatment with tap water rather than other treatments.

The response of specific effect of cultivars was obviously noticed, wherease Hamlin cultivar surpassed statistically cultivar Jaffa during two seasons of study in this respect.

- **Interaction effect:**

Regarding the interaction effect of various (growth regulators x orange cultivars) combinations **Table (28 & 29)** revealed that Hamlin cultivar treated with tap water had significantly the high number and % of developed seeds per fruit. Meanwhile, the reverse was true with Hamlin cultivar treated with CPPU at 10 ppm. In addition, other combinations were in between the aforesaid two extremes. Differences were significant as compared combinations of every category each other.

Table (28):Effect of Sitofex (CPPU) and gibberellic acid (GA_3) on No. of well developed seeds / fruit of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	9.13 a	3.87 g	**6.50 A**	8.11 a	2.26 e	**5.19 A**
CPPU at 10 ppm	6.55 c	2.73 h	**4.64 BC**	4.17 bcd	1.84 ef	**3.01 B**
CPPU at 20 ppm	6.13 cd	2.75 h	**4.44 BC**	4.23 bcd	1.80 ef	**3.02 B**
GA_3 at 100 ppm	7.32 b	2.34 h	**4.83 B**	4.81 b	1.65 ef	**3.23 B**
GA_3 at 200 ppm	7.41 b	2.55 h	**4.98 B**	4.80 b	1.47 ef	**3.27 B**
CPPU at 10 ppm + GA_3 at 100 ppm	6.39 c	2.26 h	**4.33 BC**	4.60 bc	1.29 f	**2.95 B**
CPPU at 10 ppm + GA_3 at 200 ppm	5.64 de	2.43 h	**4.04 CD**	3.89 cd	1.47 ef	**2.68 B**
CPPU at 20 ppm + GA_3 at 100 ppm	4.58 f	2.60 h	**3.59 D**	3.80 cd	1.54 et	**2.67 B**
CPPU at 20 ppm + GA_3 at 200 ppm	5.24 ef	2.68 h	**3.96 CD**	3.56 d	1.49 ef	**2.53 B**
Mean **	**6.49 A**	**2.69 B**		**4.66 A**	**1.68 B**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

Table (29): Effect of Sitofex (CPPU) and gibberellic acid (GA_3) on well developed seeds%/ fruit of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	1.49 cde	1.09 e	**1.29 B**	0.92 b	0.80 b	**0.86 A**
CPPU at 10 ppm	2.38 bc	1.11 e	**1.75 AB**	2.05 ab	0.82 b	**1.44 A**
CPPU at 20 ppm	2.47 bc	1.22 de	**1.85 AB**	1.91 ab	0.91 b	**1.41 A**
GA_3 at 100 ppm	1.78 cde	1.20 e	**1.49 AB**	2.60 a	1.15 b	**1.88 A**
GA_3 at 200 ppm	1.71 cde	1.43 cde	**1.57 AB**	2.55 a	1.15 b	**1.85 A**
CPPU at 10 ppm + GA at 100 ppm	1.54 cde	1.50 cde	**1.52 AB**	1.52 ab	1.16 b	**1.34 A**
CPPU at 10 ppm + GA at 200 ppm	2.36 abc	1.37 cde	**1.87 AB**	2.40 a	1.14 b	**1.77 A**
CPPU at 20 ppm + GA at 100 ppm	3.97 a	1.11 e	**2.54 A**	2.56 a	0.98 b	**1.77 A**
CPPU at 20 ppm + GA at 200 ppm	2.92 B	1.01 e	**1.97 AB**	2.54 a	0.99 b	**1.77 A**
Mean **	**1.23 B**	**2.29 A**		**2.12 A**	**1.01 B**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.

IV.6.3. Effect of growth regulators on number and % of shirvel seeds / fruit:

- **Specific effect:**

Data presented in **Tables (30-31)** displayed that, number and % of shirvel seeds per fruit respond to both investigated factors. Herein, CPPU at 20 ppm + GA_3 at 100 ppm resulted in an increase in number and % of shirvel seeds per fruit as compared to the other treatments.

As for specific effect of orange cultivars, it quite evident that, Jaffa orange cultivar had highest shrivel seeds than Hamlin orange cultivar during both seasons of the study.

- **Interaction effect:**

Regarding the response of shrivel seeds / fruit to interaction effect of various combinations between growth regulators and orange cultivars, it was no clear to notice that, the trend was true during two seasons of study. Jaffa orange cultivar treated with CPPU at 20 ppm + GA_3 at 100 ppm had significantly the highest shrivel seeds per fruit. Menwhile, the reverse was true with Hamlin orange cultivar and CPPU at 20 ppm + GA_3 at 100 ppm. In addition, other combinations were in between during 2002 and 2003 seasons.

These results are in general agreement with **Zhang *et al.*, (1998) and Bakry (2001) on Loquat.**

Table (30): Effect of Sitofex (CPPU) and gibberellic acid (GA_3) on No. of shirvel seeds / fruit of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	96.96 a	78.02 c	**87.49 A**	89.81 a	73.86 bc	**81.84 A**
CPPU at 10 ppm	73.35 d	71.09 e	**72.22 C**	67.04 bcd	69.17 bcd	**68.11 AB**
CPU at 20 ppm	71.28 e	68.63 g	**69.96 D**	68.89 bcd	46.42 e	**75.65 B**
GA_3 at 100 ppm	80.44 b	66.10 h	**73.27 B**	63.89 bcd	64.52 bcd	**64.20 B**
GA_3 at 200 ppm	81.25 b	64.07 i	**72.66 BC**	65.31 bcd	63.54 bcd	**64.43 B**
CPPU at 10 ppm + GA at 100 ppm	80.58 b	60.11 j	**70.35 D**	75.16 b	54.33 de	**64.75 B**
CPPU at 10 ppm + GA at 200 ppm	70.50 ef	63.95 i	**67.25 F**	61.72 bcde	56.34 de	**59.03 B**
CPPU at 20 ppm + GA at 100 ppm	53.57 k	70.08 f	**61.83 G**	59.75 bcde	61.11 bcde	**60.43 B**
CPPU at 20 ppm + GA at 200 ppm	64.22 I	72.63 d	**68.43 E**	58.36 cde	60.08 bcde	**59.22 B**
Mean **	**74.68 A**	**68.30 B**		**67.77 A**	**61.04 B**	

*** and ** refer to specific effect of growth regulators and cultivars, respectively.**

Table (31): Effect of Sitofex (CPPU) and gibberellic acid (GA_3) on shirvel seeds / fruit % of Hamlin and Jaffa orange cultivars during 2002 and 2003 seasons.

Treatments	2002		Mean*	2003		Mean*
	Hamlin	Jaffa		Hamlin	Jaffa	
Control (Tap water)	14.03 k	21.98 j	**18.01 G**	10.19 h	26.14 k	**18.17 F**
CPPU at 10 ppm	26.65 h	28.91 g	**27.78 E**	32.96 I	30.83 j	**31.89 E**
CPPU at 20 ppm	28.72 g	30.73 e	**29.73 D**	31.11 j	33.58 I	**32.35 E**
GA_3 at 100 ppm	19.56 j	33.99 d	**26.78 E**	36.11 g	35.55 gh	**35.83 D**
GA_3 at 200 ppm	18.75 d	35.93 c	**27.34 EF**	34.69 h	39.79 de	**37.42 C**
CPPU at 10 ppm + GA at 100 ppm	199.42 j	39.89 b	**29.66 D**	24.84 l	45.87 a	**35.36 D**
CPPU at 10 ppm + GA at 200 ppm	29.50 Fg	36.05 c	**32.76 B**	38.16 f	43.68 b	**40.92 A**
CPPU at 20 ppm + GA at 100 ppm	46.43 A	29.92 ef	**38.18 A**	40.25 d	38.89 ef	**39.57 B**
CPPU at 20 ppm + GA at 200 ppm	35.78 c	27.37 h	**31.58 C**	41.64 c	39.92 de	**40.78 A**
Mean **	**26.54**	**31.64**		**32.22**	**37.14**	

* and ** refer to specific effect of growth regulators and cultivars, respectively.