4. RESULT AND DISCUSSION

This experiment aimed to investigate the effect of organic and mineral nitrogen fertilizer and natural antidisease substances (garlic extract, plant guard and salicylic acid) as well as their interaction on growth, yield, fruit quality and storability of strawberry cv. Camarosa.

4.1.Effect of nitrogen fertilizer ,natural antidisease substances and their interaction on vegetative growth.

Data presented in Table (3) show the effect of organic and mineral nitrogen fertilizer as well as natural antidisease substances (garlic extract, plant guard and salicylic acid) and their interaction on vegetative growth of strawberry plants cv. Camarosa.

4.1.1. Effect of nitrogen Fertilization:-

Data in Table 3 indicate that the presence of mineral-N fertilizer alone or along with compost had better response on vegetative growth compared with 100%compost alone. Moreover, it seems that the best application level was with 50%compost-N+50%mineral-N level followed by the other combinations. Obtained results are near similar in both seasons of growth. Accordingly, using half of recommended dose of nitrogen in the form of compost and other half of nitrogen as mineral fertilizer was the most effective treatment on plant growth. However, such increments fall to reach the level of 0.05

significance in the case of plant height and number of crowns/plant during both seasons.

The increase in plant growth due to supplementation of mineral nitrogen with organic nitrogen may be attributed to that organic fertilizers release nitrogen slowly during the growing season, while mineral fertilizer can compensate the needed N. besides, organic fertilizer play an important role in improving soil physical properties and reducing PH value which affect availability of soil nutrients for uptaking by plant and consequently increased plant growth. **Cooks(1972)** suggested that application of organic and mineral N fertilizers together may increase the exchangeable water soluble of NPK and the uptake of these elements. Also, the increase in plant growth parameters were connected with the increase in photosynthetic pigments and determined macro-nutrient content (Table 4) and inturn increased plant growth. Obtained results are in same direction with those reported by **Pinamonti et al. (1997), Wang and Lin (2002), Arancon *et al* (2003 and 2004), El Araby *et al* (2003) Ezzo (2004)**, **Preusch *et al.* (2004)** on strawberry, **Abd El-Mageed *et al.* (2000)** on tomato, **Abd El-Rhman and Hosny (2001)** on eggplant.

Glessiman *et al* (1996) and Neri *et al* (2002) on strawberry indicated that plant vegetative growth measurements were less in organic production system than in conventional system in a comparison. Even though, **Wang and Lin (2002) and Arancon *et al.* (2003 and 2004)** reported that using organic fertilizer as a source of nitrogen increased growth of strawberry

plant expressed as shoot weight, dry weight, average leaf area and number of suckers produced by plants.

Kopanski and Kawecki (1994a and b), Neuweiler *et al.* (1996), Douglas and Charles (1997), Oktay *et al.* (1997), Nestby (1998), Elmer and Lamondia (1999), Mohamed and El-Miniawy (2001), Essia (2002), Gaur and Gangwar (2003), Khalaf (2003), Ram and Gaur (2003), Rana and Chandel (2003), El-Sayed (2004) and Nam *et al.* (2006) reported that increasing mineral nitrogen level had a marked effect on different measured growth parameters.

4.1.2. Effect of natural antidisease substances:

As for the effect of natural antidisease substances on vegetative growth characteristics of strawberry plant expressed as plant height, number of leaves and crowns per plant, fresh and dry weight of plant as well as leaf area (Table 3).Obtained data show clearly that spraying strawberry plants with garlic extract, plant guard and salicylic acid at 10%, 3ml/l and 5mM/l respectively, starting 75 days after transplanting and every 2 weeks intervals, increased all the aforementioned growth parameters during the two seasons of study compared with the control treatment. However , such increase in growth parameter did not reach the level of significance in case of plant height during the first season and crowns number /plant during the second one. In this respect, the highest values in all measured traits were recorded in case of using salicylic acid, plant guard and garlic extract in descending order during the two seasons of study. The increase in growth due to the application of tested stimulants may by attributed to the role of such materials as

antioxidants which contract the free radical (O_2) which affect the activity and viability of plant cells. Also it affect on physiological process of plants as well as its roles as antidiseases and consequently promote plant growth. Furthermore, increasing the duration of plant and retard the senescence of plant. In addition, the superiority of salicylic acid may be due to the role of salicylic acid as phenolic growth promoting substance which affect plant cells division and elongation and in turn increased plant growth. Obtained results are in accordance with those reported by **El-Shafie (2003)** on strawberry **Shahda (2000), Mahgoob** and **Zaghlool (2002), Fathy and Khedr (2005)** and **Jayakumar *et al* (2006),** on tomato **and El-Desouky *et al* (1998), Farid *et al* (2000a)** and **Shafshak *et al* (2004)** on squash, **Ali (1995)** on muskmelon and **Farid *et al* (2000b)** on cucumber**, Abd El-Mageed and Khafagi (1998)** on watermelon and **Gaafar *et al* (1989)**on common bean**.**

4.1.3. Effect of the interaction :

Concerning the effect of the interaction (Table 3) showed that application of nitrogen fertilizer at the recommended dose (200kg N/fed.)half of the amount as organic form and the other half as mineral form combined with spraying plants by Salicylic acid at 5mM/l starting 75 day after transplanting and every 2weeks intervals reflected the highest values in all studied growth parameters during the two seasons of study .

4.2. Chemical constituents of plant foliage:

Data recorded in Table (4) show the effect of organic and mineral nitrogen fertilizer as well as natural antidisease substances, i.e., garlic extract, plant guard and salicylic acid and

their interaction on plant foliage photosynthetic pigments (chlorophyll a, b and carotenoids) and total nitrogen, phosphorus and potassium percentage during the two seasons of growth.

4.2.1. Effect of nitrogen fertilization :

Data in Table (4) show clearly that supplementation of 25,50 ,75 or 100% from mineral nitrogen fertilizer along with organic fertilizer in the form of compost significantly increased photosynthetic pigments, i.e., chlorophyll a, b and carotenoids concentration and the percentage of total nitrogen compared to mineral-N fertilizer or compost when each used alone. Phosphorus and potassium in plant foliage were the highest with compost application alone and leded to decrease as the mineral-N increased up to 100%. In this regard, using half of recommended dose in the form of mineral nitrogen and the other half as organic nitrogen (compost) recorded the highest values in all measured photosynthetic pigments and nitrogen percentage during both seasons. However, using nitrogen fertilizer in the form of compost only at rate of 200KgN/fed (45.58m^3/fed. in the first season and 38.8m^3/fed in the second one) reflected the highest values in phosphorus and potassium concentration during the two season compared with all other tested treatments. Increasing in photosynthetic pigments content may be due to the main role of nitrogen fertilizer in the synthesis and as a constituent of chlorophyll molecule. Moreover, the increase in macro- nutrients (PK) may by attributed to the effect of organic fertilizer on reducing the PH value of the soil, increase the soil microbial biomass and humate which affect on the decomposition and availability of such nutrients which inturn

increase its uptake by plant roots. Also, addition of mineral nitrogen fertilizer increase its concentration in soil solution and in turn increased the uptake by plant. In this regard, **Hsieh and hsu(1994)**reported that the manure increase soil organic mater and the availability of P and the exchange of Mg, Mn and Zn which inturne affect leaves pigments Obtained results are in accordance with those reported by **Eissa (2002), El-Araby *et al* (2003) and El-Sayed (2004)** on strawberry**, El-Gizawy *et al* (1993a), Abd El-Aziz (1997)** on tomato**, Aricha and Bardisi (1999)** on potato**, Younes (2003)** on pepper**,** and **El-Sherif (2006)** on cucumber in case of photosynthetic pigments and **El-Oksh *et al* (1987)**, **Albregts *et al.* (1993), Baumann *et al.* (1993), Mass *et al* (1997), Mohamed and El-Miniawy (2001), Essia(2002), El-Araby *et al* (2003) , Khalaf (2003), El-Sayed (2004) and Preusch *et al* (2004)** on strawberry. **El-Kassas and Abd El-Mowly (1999), Abd-El-Mageed *et al.* (2000)** on tomato and **El-Sherif (2006)** on cucumber in case of macro-nutrients.

4.2.2. Effect of natural antidiseases substances:-

The effect of spraying natural antidiseases substances, i.e., garlic extract, plant guard and salicylic acid, on photosynthetic pigments (Chlorophyll a, b and carotenoids), total nitrogen, phosphorus and potassium percentage is presented in Table 4.Sprays significantly increased foliage chlorophyll (a& b) carotenoids ,N%, P%, K% compared to the control. In this concerning, spraying the plants with salicylic acid at 5mM/l every 2weeks intervals starting 75 days from transplanting recorded the highest increments in all assayed photosynthetic pigments and macronutrient content followed by plant guard and

garlic extract. Obtained results are nearly similar during both seasons of growth. Such increments in photosynthetic pigments and macro-nutrients may by due to the role of tested plant growth stimulants as antioxidants, its content of growth substances, its effect as antidiseases infection and consequently keeping plant health along with increasing the role of assimilation of photosynthetic pigments and absorption of macro-nutrients and resulting in increasing their concentration in plant tissues .

Similar trends were also recorded by **El-Desouky *et al.* (1998) and Shafshak *et al.* (2004)** on squash, **Fathy and Farid (2000)** on tomato, pepper and snap bean and **Kalarani *et al* (2002), Mahgoob and Zaghlool (2002) and Fathy and Khedr (2005)** on tomato.

4.2.3. Effect of the interaction:

As for the effect of the interaction between N-fertilization and natural antidiseases substances (Table 4) ,indicated that the highest values in all measured photosynthetic pigments and total nitrogen percentage as well as phosphorus and potassium percentage were recoded due to using salicylic acid at 5mM/l combined with 50% mineral nitrogen plus 50% organic nitrogen in case of photosynthetic pigments and total nitrogen, and salicylic acid combined with 100% organic nitrogen (compost) in case of phosphorus and potassium content.

4.3. Total fruit yield and its component:

Data indicated in Table (5) show cleary the effect of organic and mineral nitrogen fertilizer as well as antidisease substances , i.e., garlic extract, plant guard and salicylic acid and

their interaction on, total fruit yield and its components, i.e., early yield, marketable yield, infected fruit percentage and average fruit yield per plant ,during both seasons of study.

4.3.1.Effect of nitrogen fertilization:

Data recorded in Table (5) reveal that using compost only at arate of 200kg N/fed (45.58m^3/fed in the first season and 38.8m^3/fed In the second one) exhibited the highest early fruit yield and the lowest percentage of infected fruits during the two seasons of study compared with other studied fertilization treatments. However, plants fertilized with 50% organic nitrogen plus 50% mineral nitrogen produced the highest total fruit yield either per plant or feddan during the two seasons of growth. Also, the same data indicated that the highest marketable yield was recorded in case of fertilizing the plants with 50% compost combined with 50% of recommended dose from mineral nitrogen fertilizer, followed by treatment of 75% compost combined with 25% mineral nitrogen .

Obtained results are nearly similar during the two seasons of study. The increase in early yield when the organic fertilizer was only applied may be due to the slow release of N which reduced plant uptake of N than needed. Accordingly the plant increased the early yield in the expense of total and marketable yield.

The highest total yield and marketable yield in case of fertilization using half of recommended dose of nitrogen as compost and other half as mineral nitrogen may be attributed to the balanced uptake of N which resulted in the highest produced yield per plant or per feddan and marketable yield beside the

reasonable percentage of infected fruit (Table, 5).**Cooke(1972)** indicated that organic fertilizer encourage the plant to have good root development and mineral-N fertilizers helps the living organisms in organic matter to multiply. Obtained results are parallel with those reported by **Rocker** and **Meesters (1995), Ozguven *et al.* (1997), Ozguven (1998), Turemis (2002), Wang and Lin(2002),Ali *et al.* (2003) Arancon *et al.* (2003), Ghoneim *et al.* (2003)Arancon *et al* (2004) and Ezzo (2004)** concerning the use of organic fertilizer in strawberry plant. And **Mohamed *et al* (1989), Kopanski and Kawecki (1994b and c), Gariglio *et al.* (1996), Neuweuiler *et al*. (1996), Lamarre *et al.* (1997), Miner *et al.* (1997), Kreusel and Lenz (1998), Mohammed and El-Miniawy (2001), Essia (2002), Auter and Gaur(2003), Daugaard *et al.* (2003), Gaur and Gangwar (2003),Ghoneim *et al.* (2003), Khalaf(2003), Rana and Chandel (2003), El-Sayed (2004), Strik *et al*. (2004), Gutal *et al.* (2005), Kirschbaum *et al.* (2006), Abo-El-Hamed *et al.* (2006) and Karlidag and Yildirim (2007)** in the case of using mineral nitrogen fertilizer**.**

4.3.2. Effect of natural antidiseases substances:

The effect of natural antidisease substances, i.e., garlic extract, plant guard and salicylic acid on , early fruit yield ,total yield ,marketable yield and infection percentage is presented in Table (5). Such data indicate that early and total fruit yield either per plant or per feddan as well as marketable yield were positively affected due to spraying the plants with all tested growth stimulants(natural antidiseases substances)compared with the control treatments. Obtained results were nearly similar

during the two seasons of study. moreover, such treatments had detrimental and reducing effect on the percentage of infected fruit during the two seasons of growth. In this connection, the highest early and total produced fruit yield and the lowest percentage of infection were obtained as a result of spraying plants with salicylic acid at 5mM/l every two weeks intervals starting 75 days form transplanting. In addition, treatment of garlic extract at 10% ranked the second followed by plant guard without significant difference between them. Such increments in fruit yield (early, marketable, and total yield) due to treating the plants with tested natural products were connected with their effect on increasing the vegetative growth parameters (Table, 3) .In addition, it's effects on increasing photosynthetic pigments and macro-nutrients (Table, 4) which affect plant growth and in turn increased it's productivity. Also using such tested growth stimulants reduced the infected fruit percentage and number of days elapsed to flower anthesis and consequently increased the early and marketable produced yield. Obtained results are in parallel to that reported by **Abada *et al* (2002), El-Shafie (2003) Saber *et al.* (2003), El-Fouly (2004) and Porras *et al.* (2007)** on strawberry **and Abo-Hussein *et al* (1975), Hemly (1992),El-Dosouky *et al.* (1998), Farid *et al.* (2000a), and Shafshak *et al.* (2004))** on squash**, Kalarani *et al.* (2002) and Fathy and Khedr (2005)** on tomato**, Gaafar *et al.* (1989)** on bean**, Shabeer *et al.* (2005) and Merghany (2007)** on pea**, Abd-Megeed and Khafag (1998)** on watermelon **and Ibrahim (1998), Farid *et al.* (2000b),** on cucumber.

4.3.3. Effect of the interaction:

With regard to the effect of the interaction between nitrogen fertilization treatments and natural antidiseases substances on total fruit yield and it's components (Table, 5) show clearly that the highest total produced yield either for plant or feddan as well as marketable yield were obtained as a result of fertilizing the plant with nitrogen at 200kgN/fed in the form of 50% compost plus 50% mineral nitrogen combined with salicylic acid sprays at a rate of 5mM/l. However, fertilizing plants with nitrogen at 200kgN/fed. as compost and spraying plants with salicylic acid reflected the highest early yield and the lowest infected fruit percentage during the two season of growth.

4.4. Fruit quality:

4.4.1. Physical quality:

Data recorded in Table (6) show the effect of organic and mineral nitrogen fertilizer as well as spraying the plant with natural antidiseases substance (garlic extract, plant guard and salicylic acid) and their interaction on physical fruit characters,i.e., average fruit length, fruit diameter and fruit weight.

4.4.1.1. Effect of nitrogen fertilization:

Concerning the effect of nitrogen fertilization on physical fruit characters, i.e., average fruit length, diameter and weight, data in Table (6) show that application of nitrogen fertilizer at the recommended dose (200kgN/fed) as mineral nitrogen fertilizer exhibited the highest values in all measured fruit traits

Table(6): Effect of nitrogen fertilizer level and natural antidiseases substance on strawberry physical fruit quality during the two seasons of study.

Treatments		2005/2006			2006/2007		
		fruit length (cm)	fruit diameter (cm)	fruit weight (g)	fruit length (cm)	fruit diameter (cm)	fruit weight (g)
N fertilizers							
100% compost -N		3.12	2.24	13.01	3.21	2.26	12.91
75 % compost-N+25% mineral-N		3.19	2.34	13.43	3.26	2.31	13.96
50 % compost-N+50% mineral-N		3.21	2.35	14.43	3.27	2.38	14.13
25 % compost-N+ 75%mineral-N		3.30	2.40	14.73	3.30	2.42	14.72
100 % mineral –N fertilizer		3.37	2.40	16.21	3.39	2.49	15.76
L.S.D. at 0.05		0.096	0.082	0.75	0.01	0.077	0.64
Natural antidiseases substance							
Control		3.13	2.22	13.01	3.22	2.25	13.45
Garlic extract		3.21	2.33	14.40	3.26	2.36	14.11
Plant guard		3.21	2.33	14.32	3.28	2.37	14.42
Salicylic acid		3.39	2.50	15.72	3.38	2.51	15.20
L.S.D. at 0.05		0.064	0.06	0.67	0.07	0.04	0.57
Interactions							
100% compost-N	**Control**	3.00	2.17	11.50	3.12	2.12	11.90
	Garlic extract	3.15	2.16	13.15	3.21	2.23	13.25
	Plant guard	3.12	2.24	13.15	3.19	2.31	12.67
	Salicylic acid	3.22	2.38	14.27	3.31	2.37	13.85
75 % compost-N+ 25% mineral-N	**Control**	3.08	2.15	12.85	3.17	2.13	13.05
	Garlic extract	3.22	2.34	13.87	3.27	2.34	14.0
	Plant guard	3.17	2.32	12.45	3.29	2.29	14.20
	Salicylic acid	3.27	2.57	14.55	3.30	2.47	14.62
50 % compost-N+50% mineral-N	**Control**	3.15	2.23	13.42	3.22	2.21	13.70
	Garlic extract	3.18	2.36	14.02	3.20	2.40	13.80
	Plant guard	3.17	2.31	14.45	3.28	2.40	13.80
	Salicylic acid	3.35	2.48	15.85	3.37	2.51	15.22
25 % compost-N+ 75% mineral-N	**Control**	3.22	2.26	12.90	3.27	2.36	14.22
	Garlic extract	3.23	2.40	14.90	3.33	2.35	14.40
	Plant guard	3.30	2.40	15.07	3.25	2.39	14.97
	Salicylic acid	3.46	2.52	16.05	3.37	2.59	15.25
100 % mineral –N fertilizer	**Control**	3.24	2.28	14.40	3.34	2.42	14.40
	Garlic extract	3.29	2.40	16.07	3.31	2.49	15.12
	Plant guard	3.31	2.40	16.50	3.38	2.45	16.47
	Salicylic acid	3.65	2.54	17.90	3.56	2.61	17.07
L.S.D. at 0.05		0.11	0.13	1.5	0.12	0.16	1.3

compared with other studied fertilization treatments during both seasons of study. On the other hand, application of nitrogen fertilizer at 100% compost reflected the lowest values of average fruit length, diameter and weight during the two seasons of growth.

In this concern, the highest values in fruit parameters due to using nitrogen fertilizer in a mineral form (200kg/fed) may be due to the role of nitrogen in increasing the moisture content of fruit cells and also increasing the size and number of cells in fruit receptacle which affect the measured fruit parameter. In this respect, **Lamarre *et al.*(1997), Ozguven (1998), Essia (2002), Wang and Lin (2002), Rana and Chandel (2003), Gaur and Gangwer (2003), Ghoneim *et al.*(2003), El-Sayed (2004), Ezzo (2004)**, **and Abo-El-Hamed *et al*. (2006)** reported that nitrogen fertilizer application had an increasing effect on increasing measured physical fruit characters, However, **Yoshida (1992), Mohamed and El-Miniawy (2001) and Arancon *et al.* (2004)** indicated that nitrogen had no effect on fruit physical characteristics.

4.4.1.2. Effect of natural antidiseases substances:

With regard to the effect of tested natural antidiseases substances (Table 6),data revealed that spraying plants with salicylic acid at 5 mM/l, garlic extract at 10% and plant guard at 3ml/l every two weeks intervals starting 75 days after transplanting significantly increased average fruit length, diameter and weight compared with the control treatment. In addition, treating plants with salicylic acid at 5 mM/l was superior than the other tested natural antidiseases substances and

the control treatment during both season of growth. Such increment in fruit parameters due to salicylic acid treatment may be attributed to the role of salicylic acid on increasing the uptake of NPK (Table, 4) and the absorption of water by roots which in turn increased fruit size. Similar observations were recorded by **El-Shafie (2003) and Babalar *et al.* (2007)** on strawberry**, Eid and Mahdy (1988)** on watermelon, **El-Desouky *et al.* (1998) and Shafshak *et al.* (2004)** on squash and **Mahgoob and Zaghlool (2002)** on tomato indicating that application of garlic extract at 10%, plant guard at 3ml/l and salicylic acid at 5mM/l enhanced the physical fruit characters in such crops

4.4.1.3. Effect of the interaction :

As for the effect of the interaction, data in Table (6) indicate that the highest values in all measured fruit parameters (weight, length and diameter) were obtained as a result of the combination between nitrogen fertilization at 200 kg N/fed. as a mineral form combined with the salicylic acid at 5mM/l sprays during the two seasons of growth.

4.4.2. Chemical fruit quality:

Data presented in Table (7) indicate the effect of organic and mineral nitrogen fertilizer as well as natural antidiseases substances and their interaction on chemical constituents of fruit, i.e., TSS%, vitamin C and anthocyanin concentration as well as total acidity, total sugars and reducing sugars percentage during the two seasons of study.

4.4.2.1. Effect of nitrogen fertilization :

Data recorded in Table (7) indicate that irrespective of total acidity percentage which was increased as a result of using

100% mineral nitrogen fertilizer at the recommended dose, total soluble solids, vitamin C, anthocyanin, total sugars and reducing sugars percentage were significantly increased as a result of using nitrogen fertilizer as 100% organic form (compost) compared with the other tested fertilizer treatment. Such results are true during the two seasons of growth. In this regard, such reduction in TSS%, vitamin C, anthocyanin with increasing mineral nitrogen application from 25, 50, 75 up to 100% of recommended dose are connected with reducing the total and reducing sugars which is used in catabolism or formation of new cells in fruits and consequently increased fruit physical parameters (average fruit weight, fruit length and fruit diameter). Also increasing the ratio of mineral nitrogen increased the moisture content of fruit and inturn had a negative effect on sugars content in fruit juice **(Neuweiler *et al.*, 1996)**. Obtained results are agree with those reported by **Lucka *et al.* (1975), Singh and Singh (1979), Ozguven (1998), Wang and Lin (2002 and 2003) and Ghoneim *et al.* (2003), Ezzo (2004)** concerning the use of organic fertilizer and **Mohamed *et al.* (1989), Kopanski and Kawecki (1994c), Miner *et al.* (1997), Nestby (1998), Mohamed and El-Miniawy (2001), Mukkun *et al.* (2001), Essia (2002), Ali *et al.* (2003), Gaur and Gangwar (2003), Ram and Gaur (2003), Rana and Chandel (2003)**, **El-Sayed (2004), Moor *et al.* (2005), Abo-El-Hamed *et al.* (2006) and Karlidag and Yildirim (2007)** in case of using mineral nitrogen fertilizer.

4.4.2.2. Effect of natural antidiseases substances:

Table(7) shows the effect of garlic extract, plant guard and salicylic acid on chemical constituents of fruit, i.e., TSS%, vitamin C, anthocyanin, total acidity, total sugars and reducing sugars concentration. As shown, all aforementioned chemical constituents were significantly affected by spraying plants with tested natural antidiseases substances compared with the control treatments. Obtained results are the same during the two seasons of growth. In addition, the highest values in all assayed chemical constituents except total acidity were recorded in case of spraying plants with salicylic acid at a rate of 5mM/l during the two growth seasons. However, the highest values for total acidity were obtained in case of fruit harvested from the control treatment during both seasons of study. Such increments in chemical fruit quality agents due to the effect of different studied growth stimulants are connected with the increase in photosynthetic pigments which in turn affect on the rate of organic compound assimilation and consequently increased such assayed organic constituents. Obtained results are in the same direction to those recorded by **Youness (2002), El-Shafie (2003) and El-Fouly (2004)** on strawberry and **Kalarani *et al.* (2002) and Fathy and Khedr (2005)** on tomato and **Farid *et al.* (2000), Shafshak *et al.* (2004)** on squash ,**Eid and Mahdy (1988)** on watermelon. **Merghany(2007)**on pea

4.4.2.3. Effect of the interaction:

As for the effect of the interaction, data recorded in Table (7) show that the highest values in TSS, vitamin C, anthocyanin, total sugars and reducing sugars concentration and the lowest

value in total acidity were obtained in case of application of nitrogen fertilizer at the recommended dose (200 kgN/fed.) in the form of 100% organic manure and spraying the plants with salicylic acid at 5mM/l every 15 days intervals starting 75days after transplanting. The obtained results followed similar trend in both seasons of study.

4.5. fruit storability

Storability of strawberry fruits can be judged through weight loss ,decay percentage and chemical constituents (such as changes in TSS, total titratable acidity, vitamin C, total sugars, reducing sugars and anthocyanin content).

4.5.1. Effect of mineral and organic nitrogen fertilizer on :

4.5.1.1. Weight loss percentage :

Data presented in Table (8) show the effect of mineral and organic nitrogen fertilizers as well as their combination and storage period on weight loss percentage under cold storage conditions (zero). Such data indicate that there were asignificant differences among the studied fertilization treatments in total weight loss of strawberry fruits during the storage.

In this respect, the lowest percentage of weight loss was recorded in case of fertilization with nitrogen fertilizer at the recommended dose (200kg N/fed.) as compost only followed by using nitrogen fertilizer as 75% ,50%,25% and 100%mineral fertilizer. Moreover, increasing the percentage of added mineral nitrogen up to 100% of recommended dose significantly increased the percentage of weight loss in fruit during the storage. On the other hand, the highest percentage of weight loss

was obtained in case of using mineral nitrogen at 100% of recommended dose (200kg N/fed.). Obtained results are nearly similar during both seasons of study. Such increases in weight loss percentage with increasing the percentage of mineral nitrogen in applied fertilizer may be attributed to the increase in moisture content and the decrease of TSS (Table, 7) in fruits due to nitrogen application. In this respect, **Shafshak (1961), Omran (1962) and El-Sheikh (1988)** on tomato and **Ahmed (1994)** on squash, reported that increasing mineral nitrogen fertilizer level increased weight loss percentage of fruits during storage.

On the other hand, **El-Sheikh and Salama (1997), Nanthakumer and Veevavagavathatham (1999) and Krishna and Krishnappa (2002)** on tomato and **Sameera *et al.* (2005)** on okra, indicated that using nitrogen fertilizer as organic form (chicken manure, FYM or vermicompost) improved fruit quality and decrease weight loss percentage.

4.5.1.2. Effect of natural antidiseases substances:

Data in Table (9) illustrated that preharvest spray of strawberry plants with garlic extract at 10%, plant guard at 3ml/l and salicylic acid at 5mM/l significantly decreased the percentage of weight loss in fruits during storage compared with the chick treatment during the both seasons of study. In this connection, the lowest weight loss was recorded in case of using salicylic acid followed by garlic extract and plant guard. Such positive effect for using salicylic acid, garlic extract and plant guard treatments was true during the two seasons of growth. Obtained results may be attributed to the role of such natural antidiseases substances in decreasing the susceptibility for

diseases infection, decreasing the respiration rate and production of ethylene which affect greatly on fruit storageability. In this concern, **El-Shafie (2003) and Babalar *et al.* (2007)** on strawberry and **Sanwal and Payasi (2007)** on banana reported that using plant guard, salicylic acid and garlic extract respectively decreased weight loss percentage in storage fruits, Earlier **Wills *et al.*(1998**) illustrated that salicylic acid can decrease fruit metabolic activities resulting in a decrease in fruit water loss

4.5.1.3. Effect of storage period:

Data in Table (10 and11) show clearly that the weight loss percentage of fruit was steadily and constantly increased with prolonging the storage period. In this regard, the highest weight loss percentage was noticed after 20 days of storage. Similar results were recorded in the two seasons of study. Obtained results may be due to the loss of water and degradation and use of complex molecules in respiration, which affect firmness of fruits and make it to be susceptible for infection and more perishable.

4.5.1.4. Effect of the interaction:

Data in Table (10 and 11) indicate that there was a significant effect in fruit weight loss percentage as a result of the interaction between the different fertilization treatments and natural antidiseases substances within the different periods during the storage. In this regard, the lowest value of weight loss percentage was recorded incase of using 100% organic fertilizer as compost combined with spraying the plants with salicylic acid at 5mM/l after 75 days from transplanting and every two weeks

Table (10): Effect of the interaction of nitrogen fertilizer, natural antidiseases substance and storage period on strawberry weight loss percentage in first season

Treatments		2005/2006										
		2 days	4 days	6 days	8 days	10 days	12 days	14 days	16 days	18 days	20 days	Mean
100% Compost	Control	0.87	1.41	1.95	2.63	2.94	3.24	3.76	3.85	3.93	4.13	2.87
	Garlic extract	0.79	1.28	1.57	2.19	2.47	2.73	2.95	3.12	3.34	3.52	2.38
	Plant guard	0.81	1.32	1.62	2.24	2.53	2.87	3.04	3.27	3.45	3.76	2.49
	Salicylic acid	0.76	1.18	1.38	1.91	2.36	2.56	2.65	2.98	3.14	3.37	2.22
75% Compost + 25 %mineral	Control	0.96	1.47	1.98	2.75	2.98	3.31	3.80	3.96	4.0	4.19	2.94
	Garlic extract	0.85	1.32	1.60	2.23	2.50	2.76	3.03	3.28	3.41	3.59	2.45
	Plant guard	0.87	1.36	1.68	2.31	2.56	2.93	3.12	3.39	3.57	3.81	2.56
	Salicylic acid	0.80	1.24	1.43	2.11	2.42	2.60	2.73	3.05	3.29	3.42	2.32
50% Compost + 50% mineral	Control	0.99	1.49	2.02	2.77	2.99	3.36	3.83	3.99	4.05	4.27	3.01
	Garlic extract	0.87	1.36	1.68	2.25	2.54	2.81	3.10	3.3	3.45	3.63	2.51
	Plant guard	0..89	1.39	1.74	2.36	2.63	2.91	3.18	3.42	3.62	3.85	2.59
	Salicylic acid	0.82	1.25	1.48	2.16	2.44	2.63	2.88	3.11	3.40	3.56	2.37
25% Compost + 75% mineral	Control	1.10	1.58	2.12	2.85	3.09	3.44	3.91	4.16	4.42	4.72	3.14
	Garlic extract	0.90	1.39	1.76	2.32	2.61	2.92	3.35	3.60	3.86	3.89	2.65
	Plant guard	0.93	1.43	1.85	2.43	2.66	2.99	3.46	3.65	3.91	4.02	2.62
	Salicylic acid	0.87	1.28	1.52	2.21	2.49	2.74	2.95	3.27	3.46	3.79	2.45
100% Mineral	Control	1.13	1.72	2.19	2.99	3.13	3.59	4.01	4.28	4.65	4.90	3.26
	Garlic extract	0.92	1.42	1.75	2.38	2.66	3.04	3.49	3.71	3.92	3.99	2.72
	Plant guard	0.97	1.45	1.81	2.51	2.73	3.10	3.58	3.82	3.99	4.15	2.83
	Salicylic acid	0.89	1.30	1.62	2.29	2.52	2.80	3.12	3.39	3.62	3.85	2.53
Mean		0.89	1.38	1.74	2.40	2.67	2.97	3.28	3.52	3.72	3.90	0.02*
L.S.D at 0.05		0.09										0.029

* **LSD** to the mean of storage periods

Table (11): Effect of the interaction of nitrogen fertilizer, natural antidiseases substance and storage period on weight loss percentage in second season

Treatments		2006/2007										
		2 days	4 days	6 days	8 days	10 days	12 days	14 days	16 days	18 days	20 days	Mean
100% Compost	Control	0.94	1.59	2.22	2.81	2.99	3.26	3.82	3.91	3.98	4.21	**2.91**
	Garlic extract	0.83	1.31	1.91	2.12	2.45	2.79	2.99	3.15	3.29	3.59	**2.45**
	Plant guard	0.86	1.39	1.98	2.27	2.52	2.95	3.14	3.29	3.51	3.87	**2.57**
	Salicylic acid	0.78	1.23	1.59	1.79	2.10	2.49	2.75	3.05	3.19	3.46	**2.24**
75% Compost + 25 %mineral	Control	0.99	1.64	2.41	2.89	3.12	3.43	3.92	3.99	4.10	4.37	**3.08**
	Garlic extract	0.88	1.36	2.0	2.19	2.57	2.88	3.11	3.19	3.45	3.72	**2.53**
	Plant guard	0.91	1.45	2.10	2.24	2.59	3.0	3.19	3.28	3.59	3.87	**2.57**
	Salicylic acid	0.82	1.27	1.83	1.92	2.15	2.50	2.84	3.12	3.40	3.61	**2.34**
50% Compost + 50% mineral	Control	1.01	1.67	2.59	2.95	3.18	3.57	3.97	4.06	4.19	4.40	**3.16**
	Garlic extract	0.90	1.38	2.05	2.28	2.62	2.93	3.17	3.27	3.58	3.79	**2.59**
	Plant guard	0.94	1.46	2.14	2.37	2.68	3.12	3.21	3.35	3.75	3.92	**2.69**
	Salicylic acid	0.84	1.32	1.90	1.98	2.23	2.56	2.99	3.19	3.51	3.71	**2.47**
25% Compost + 75% mineral	Control	1.15	1.80	2.78	3.05	3.33	3.78	4.12	4.18	4.51	4.85	**3.35**
	Garlic extract	0.94	1.43	2.18	2.41	2.82	3.07	3.29	3.40	3.79	3.91	**2.72**
	Plant guard	0.98	1.49	2.22	2.59	2.89	3.16	3.35	3.51	3.99	4.14	**2.83**
	Salicylic acid	0.89	1.38	1.95	2.0	2.28	2.83	3.1	3.26	3.50	3.86	**2.50**
100% Mineral	Control	1.18	1.94	2.90	3.19	3.49	3.99	4.22	4.27	4.70	4.93	**3.48**
	Garlic extract	0.97	1.51	2.25	2.47	2.89	3.15	3.40	3.59	3.98	4.0	**2.82**
	Plant guard	1.0	1.56	2.29	2.63	2.92	3.23	3.49	3.63	4.10	4.18	**2.90**
	Salicylic acid	0.93	1.47	1.99	2.10	2.37	2.92	3.17	3.46	3.66	3.95	**2.60**
Mean		0.96	1.48	2.16	2.41	2.68	3.06	3.36	3.50	3.78	4.01	0.02*
L.S.D at 0.05		0.12										**0.04**

* **LSD** to the mean of storage period

intervals. On the contrary, fertilizing strawberry plants with nitrogen fertilizer at 200kg-N/fed at mineral form (100%) reflected the highest weight loss percentage within the different periods of storage during the two seasons of study.

4.5.2. Decay percentage:

Data presented in Tables (12 to 15) show the effect of mineral and organic nitrogen fertilization and natural antidiseases substances as well as their interaction on decay percentage of fruits during the storage in both seasons.

4.5.2.1. Effect of nitrogen fertilization:

Data in Table (12) indicate that there were a significant differences in decay percentage of fruits during the storage among the studied fertilization treatments. In this regard, application of nitrogen fertilizer at the recommended dose (200kg N/fed.) as 100% compost reflected the lowest decay percentage of fruits during the storage. Increasing the percentage of nitrogen fertilizer as mineral form up to 100% significantly increased the percentage of fruit decay compared with using nitrogen fertilizer as 100% compost.

Similar results were recorded in both seasons of study. Such negative effect of increasing the percentage of mineral nitrogen on fruit storageability traits (decay) may be due to increasing the sensitivity of fruit to infection with diseases and the highest moisture content of fruits which makes the fruit more susceptible for decaying. In this respect, **El-Sheikh and Slama (1997)** reported that organic fertilization by chicken manure improved storage life of tomato fruits by decreasing decay percentage. On the other hand, **Shafshak (1961), Omran (1962)**

Table (12): Effect of nitrogen fertilizer and storage period on strawberry decay percentage during the storage in both seasons of study.

Treatments	2005/2006										
	2 day	4 day	6 day	8 day	10 day	12 day	14 day	16 day	18 day	20 day	Mean
100% compost-N	0.00	0.00	4.20	7.88	10.51	18.36	24.22	32.91	41.10	48.54	18.77
75% compost-N + 25% mineral-N	0.00	0.00	4.48	8.26	11.37	21.53	26.15	35.17	42.70	50.29	20.0
50% compost-N + 50% mineral-N	0.00	0.00	4.85	8.78	13.11	22.59	28.11	36.33	44.45	51.60	20.98
25% compost-N + 75% mineral-N	0.00	0.00	5.35	9.47	15.58	24.77	30.21	39.22	47.18	54.16	22.60
100% mineral-N	0.00	0.00	5.60	9.92	16.63	26.46	33.25	41.15	49.56	56.15	23.81
L.S.D. at 0.05	0.31										0.10
2006/2007											
Items	2 day	4 day	6 day	8 day	10 day	12 day	14 day	16 day	18 day	20 day	Mean
100% compost-N	0.00	0.00	4.29	7.97	11.47	17.38	24.31	32.45	42.42	49.05	18.93
75% compost-N + 25% mineral-N	0.00	0.00	4.49	9.09	12.71	21.10	27.28	35.43	43.77	50.81	20.43
50% compost-N + 50% mineral-N	0.00	0.00	4.92	9.61	14.29	22.24	28.43	36.82	44.92	52.27	21.35
25% compost-N + 75% mineral-N	0.00	0.00	5.44	10.63	15.76	24.19	31.24	39.65	46.09	54.85	22.78
100% mineral-N	0.00	0.00	5.75	11.74	16.60	25.16	33.89	41.66	49.81	56.63	24.13
L.S.D. at 0.05	0.63										0.20

and El-Sheikh (1988) on tomato, **Ahmed (1994)** on squash, reported that increasing mineral nitrogen fertilizer level increased decay percentage of fruit during storage.

4.5.2.2. Effect of natural antidisease substances:

The effect of tested natural antidiseases substances, i.e., garlic extract, plant guard and salicylic acid on decay percentage of fruits is presented in Table (13) . The preharvest foliar spray of strawberry plants with such substances significantly decreased the decay percentage of fruits compared with the control treatment during the storage in both seasons of study. In this respect, the lowest values of decay were recorded in case of using salicylic acid, garlic extract and plant guard in descending order. In this concern, the decrement effect of tested substances on decay percentage may be due to the role of such substances in eliminating microbial harmful effect, slowing the activity of analytical enzymes, preventing softening and retaining the firmness of fruit during storage. **Babalar *et al.* (2007)** reported that salicylic acid can prevent postharvest decay of strawberry fruit and **Goetze et al (1999**) as well as **Lu and Chen (2005**) pointed out to its prevention of decay fungi growth

Similar trends were reported by **El-Shafie (2003) and Babalar *et al.* (2007)** on strawberry and **Sanwal and Payasi (2007)** on banana.

4.5.2.3. Effect of storage period:

Data in Tables 14 and 15 show clearly that the decay percentage was significantly increased with extending the storage period up to 20 days of storage. Such results are observed during both seasons of study. In this concern,

Table (13): Effect of natural antidiseases substance and storage period on strawberry decay percentage during the storage in both seasons of study.

Treatments	2005/2006										
	2 day	**4 day**	**6 day**	**8 day**	**10 day**	**12 day**	**14 day**	**16 day**	**18 day**	**20 day**	**Mean**
Control	0.00	0.00	5.73	10.93	16.18	25.43	31.94	40.75	48.76	55.91	23.56
Garlic extract	0.00	0.00	4.65	8.34	12.50	21.97	27.73	36.09	43.71	51.14	20.61
Plant guard	0.00	0.00	4.97	8.87	13.74	23.33	29.44	37.54	45.48	52.71	21.61
Salicylic acid	0.00	0.00	4.24	7.32	11.35	20.23	24.43	33.44	42.05	48.83	19.19
L.S.D. at 0.05	**0.28**										**0.09**
2006/2007											
Items	**2 day**	**4 day**	**6 day**	**8 day**	**10 day**	**12 day**	**14 day**	**16 day**	**18 day**	**20 day**	**Mean**
Control	0.00	0.00	5.81	11.55	16.46	24.23	33.51	41.78	49.98	57.03	24.04
Garlic extract	0.00	0.00	4.76	9.56	13.79	21.71	27.70	36.44	44.73	51.56	21.03
Plant guard	0.00	0.00	5.13	9.94	14.85	22.65	30.52	38.21	46.41	53.78	22.15
Salicylic acid	0.00	0.00	4.21	8.18	11.57	19.47	24.39	32.38	40.48	48.52	18.92
L.S.D. at 0.05	**0.57**										**0.18**

Table (14): Effect of the interaction of nitrogen fertilizer, natural antidiseases substance and storage period on strawberry decay percentage in first season

Treatments		2005/2006										
		2 days	4 days	6 days	8 days	10 days	12 days	14 days	16 days	18 days	20 days	Mean
100% Compost	Control	0	0	4.78	9.82	12.74	21.50	28.16	36.75	44.75	51.26	20.96
	Garlic extract	0	0	4.14	7.63	9.96	17.25	23.12	32.36	39.60	47.91	18.19
	Plant guard	0	0	4.42	7.96	10.54	18.96	24.95	33.81	41.25	49.36	19.13
	Salicylic acid	0	0	3.65	6.14	8.79	15.73	20.64	28.75	38.25	45.75	16.82
75% Compost + 25 %mineral	Control	0	0	4.95	10.21	14.15	23.14	29.75	38.50	46.81	53.26	22.08
	Garlic extract	0	0	4.38	7.90	10.36	21.43	25.10	34.52	41.50	49.15	19.43
	Plant guard	0	0	4.69	8.14	11.67	22.75	57.50	35.72	42.60	51.25	20.41
	Salicylic acid	0	0	3.94	6.75	9.29	18.81	22.50	31.92	39.91	47.50	18.06
50% Compost + 50% mineral	Control	0	0	5.75	10.63	15.32	24.95	30.91	39.95	48.10	55.26	23.09
	Garlic extract	0	0	4.63	8.35	12.25	21.95	27.21	35.72	43.60	50.10	20.42
	Plant guard	0	0	4.93	8.92	14.10	23.15	29.26	37.15	44.80	52.75	21.49
	Salicylic acid	0	0	4.12	7.26	10.75	20.31	24.60	32.50	41.50	49.30	18.93
25% Compost + 75% mineral	Control	0	0	6.35	11.87	18.75	27.81	33.75	43.12	50.91	58.65	25.12
	Garlic extract	0	0	4.99	8.72	14.52	23.74	29.60	38.12	45.75	53.80	21.96
	Plant guard	0	0	5.40	9.50	15.94	25.10	31.30	39.75	48.12	54.10	22.92
	Salicylic acid	0	0	4.61	7.82	13.12	22.10	26.15	35.91	43.95	50.10	20.39
100% Mineral	Control	0	0	6.26	12.12	19.93	29.75	37.12	45.50	53.25	61.25	26.58
	Garlic extract	0	0	5.26	9.15	15.41	25.16	33.12	39.75	48.12	54.75	23.07
	Plant guard	0	0	5.43	9.79	16.36	66.71	34.65	41.25	50.75	56.10	24.09
	Salicylic acid	0	0	4.82	8.65	14.79	24.21	28.25	38.12	46.12	52.50	21.75
Mean		0.00	0.00	4.90	8.86	13.44	22.74	28.39	36.96	45.0	52.15	0.14*
L.S.D at 0.05		0.63										0.20

* **LSD** to the mean of storage periods

Table (15): Effect of the interaction of nitrogen fertilizer, natural antidiseases substance and storage period on strawberry decay percentage in second season

Treatments		2005/2006										
		2 days	4 days	6 days	8 days	10 days	12 days	14 days	16 days	18 days	20 days	Mean
100% Compost	Control	0	0	4.90	9.50	14.90	20.96	29.35	37.50	46.25	53.60	**20.70**
	Garlic extract	0	0	4.25	7.86	10.50	16.75	22.81	31.35	42.75	47.10	**18.29**
	Plant guard	0	0	4.51	8.10	11.25	17.50	24.10	33.75	43.86	50.4	**19.38**
	Salicylic acid	0	0	3.52	6.45	9.21	14.25	20.95	27.25	36.90	45.10	**16.36**
75% Compost + 25 %mineral	Control	0	0	4.99	10.84	15.35	22.75	31.64	39.12	48.00	54.25	**22.54**
	Garlic extract	0	0	4.42	8.56	12.10	21.10	26.45	35.31	43.85	50.5	**20.23**
	Plant guard	0	0	4.52	8.95	13.62	22.21	28.10	36.70	45.00	52.15	**21.14**
	Salicylic acid	0	0	3.96	7.99	9.87	18.35	22.95	30.59	38.12	47.90	**17.96**
50% Compost + 50% mineral	Control	0	0	5.90	11.29	16.21	24.25	33.12	40.51	49.50	56.20	**23.70**
	Garlic extract	0	0	4.70	9.25	14.35	21.99	27.50	36.75	44.20	51.95	**21.04**
	Plant guard	0	0	4.97	9.82	15.12	23.10	29.00	38.12	45.9	52.74	**21.84**
	Salicylic acid	0	0	4.10	8.10	11.50	19.95	24.10	32.40	40.0	48.20	**18.83**
25% Compost + 75% mineral	Control	0	0	6.30	12.14	17.36	26.36	36.20	44.25	51.2	59.50	**25.45**
	Garlic extract	0	0	5.10	10.53	15.61	24.00	29.95	38.90	43.20	53.12	**22.05**
	Plant guard	0	0	5.75	10.92	16.75	24.91	33.12	40.50	46.10	55.90	**23.41**
	Salicylic acid	0	0	4.62	8.92	13.24	21.85	26.50	34.94	42.90	50.20	**20.24**
100% Mineral	Control	0	0	6.99	13.95	18.45	28.16	38.75	47.50	54.0	63.12	**26.80**
	Garlic extract	0	0	5.40	11.62	16.32	25.00	32.12	39.89	49.75	55.20	**23.51**
	Plant guard	0	0	5.90	11.93	17.50	25.90	35.10	42.50	51.0	57.0	**24.99**
	Salicylic acid	0	0	4.90	9.41	14.0	22.90	28.26	36.75	44.50	51.20	**21.21**
Mean		0.00	0.00	4.98	9.81	14.17	22.01	29.03	37.20	45.40	52.72	0.16*
L.S.D at 0.05		1.279										**0.404**

* **LSD** to the mean of storage periods

El-Shafie (2003) reported similar trend, where the decay percentage was increased with increasing storage period up to 9 days of storage.

4.5.2.4. Effect of the interaction:

As for the effect of the interaction, data in Tables 14 and 15 reveal that using nitrogen fertilizer as compost at a rate of 200kg N/fed and preharvest spray with salicylic acid at 5mM/l. exhibited the lowest decay percentage of fruits during the different periods of storage in both seasons of study. On the other hand, the highest decay was with nitrogen fertilizer as 100% mineral form without any sprays. Decay percentage was increased as storage period was prolonged up to 20 days.

4.5.3. Chemical constituents :

Data illustrated in Tables 16 to 33 show the effect of nitrogen fertilization, natural antidiseases substance, storage period as well as their interaction on changes in fruit chemical constituents under cold storage condition in the two seasons of study.

4.5.3.1. Effect of nitrogen fertilization

Data recorded in Table 16 to 21 show the effect of mineral and organic nitrogen fertilizers as well as their mixtures on changes in chemical constituents of strawberry fruits during the storage. Such data indicated that irrespective of total titratable acidity which was increased with increasing the percentage of mineral nitrogen in used fertilizer up to 100%, all the estimated chemical constituents, i.e., TSS, vitamin-C, anthocyanin pigments, total and reducing sugars were significantly decreased with increasing the percentage of mineral

nitrogen in mixture of used fertilizer up to 100% mineral nitrogen. Such decrease in total acidity of fruits are negatively connected with sugars content which increased with decreasing the percentage of mineral nitrogen in tested fertilizers. In addition the increase of TSS in fruits at the end of storage period in case of increasing the quality of used organic nitrogen fertilizer up to 100% compost may be due to the initial highest content of TSS in fruits before storage and the decrease in moisture content by evaporation during the storage. Moreover, the highest content of anthocyanin and sugars in100% organic nitrogen fertilizer was connected with the higher content of TSS in fruits in such treatments. Obtained results agree with these reported by **Ploger *et al.* (1989), Vogtmann *et al.* (1993), El-Sheikh and Salama (1997)** on tomato, **Sameera *et al.* (2005)** on Okra organic fertilizer treatment (compost) gave superior results on storage ability and chemical content of fruits (Tss, vitamin-C, total and reducing sugars) while **Mukkun *et al.* (2001)** on strawberry **El-Sheikh (1988)** on tomato, **Ahmed (1994)** on squash, **Yommi *et al.* (1995)** on tomato in the case of mineral fertilizer.

4.5.3.2. Effect of natural antidiseases substances:

Data presented in Table 22 to 27 show the effect of different tested natural antidisease substances, i.e., garlic extract, plant guard and salicylic acid on changes in chemical constituents of strawberry fruit during storage (Tss, total titratable acidity, vitamin C, anthocyanin pigment and total and reducing sugars). Such data indicate that except both total acidity and vitamin C concentration which was decreased during

storage, each of Tss, total and reducing sugar percentage as well as anthocyanin concentration were gradually and steadily increased during the storage periods up to 20 days of storage compared with the control treatment during the two season of growth. In addition, the highest values in all assayed chemical constituents except total acidity were noticed in case of pre-harvest spraying the plants with salicylic acid at 5mM/l followed by garlic extract and plant guard. However, the highest acidity concentration was recorded in case of the control treatment. In this respect, such increase in Tss, anthocyanin, total and reducing sugars concentration during the storage may be attributed to the moisture less through evaporation and the changes of some complex compound in fruits to simple substances. However, **El-Shafie (2003)** indicated that plant guard and promot significantly decreased total soluble solids and total titratable acidity during the different periods of storage up to 9days .

4.5.3.3. Effect of storage period:

As for the effect of storage periods the same data in Tables 28 t o 33 indicate that irrespective of total titratable acidity and vitamin C which were decreased during the different periods of storage, total soluble solids, anthocyanin pigments as well as total and reducing sugars were increased with prolonging the storage period upto 20 days of storage. Obtained results are the same during the two seasons of growth.

4.5.3.4. Effect of the interaction:

With regard to the effect of the interaction between the different studied treatments, data in Tables 28 to33 indicate that there are asignificant effect on all determined chemical

constituents due to the different interactions between the studied treatments. In this regard, the highest value of TSS, vitamin C, anthocyanin, total and reducing sugars and the lowest acidity were obtained in case of using nitrogen fertilizer as compost only (at a rate of 200 kg N/fed.) and preharvest spraying the plants with salicylic acid at 5mM/l during the different periods of storage and at the end of storage period (20 days of storage). Obtained results are similar during both seasons of study.