Results and Discussion

4. RESULT AND DISCUSSION

4.1. First experiment, Effect of NPK mineral fertigation and foliar spray with Hammer® and Pepton® as well as their interaction on vegetative growth, chemical composition, fruit yield and its quality of strawberry plants cv. Sweet Charlie.

4.1.1. Vegetative growth characteristics.

Data recorded in Tables (1 and 2) indicate the effect of fertigation using mineral (NPK) fertilizers and spray with natural compounds as well as their interaction on vegetative growth aspects of strawberry plants during 2007/2008 and 2008/2009 seasons.

a. Effect of mineral fertilizers.

Data presented in Tables (1 and 2) show that application of mineral fertilizers, i.e., ammonium sulphate as a source of nitrogen, phosphoric acid (60%) a source of phosphorus and potassium sulphate as source of potassium at the recommended dose (200kg N, 80 kg P_2O_5 and 240 K_2O/Fed.) or at 25% more or less than the recommended dose significantly affected all the studied growth traits i.e., plant height, number of leaves and secondary crowns per plant as well as crown diameter, average leaf area and fresh and dry weight per plant during both seasons of study . In this respect, increasing the rate of application by 25 % of recommended dose (250 kg N, 100 kg P_2O_5 and 300 kg K_2O/ fed) significantly reflected the highest values in all studied growth traits compared with using the recommended

Table (1): Effect of fertgation using NPK mineral fertilizers and foliar spray with organic compounds as well as their interaction on vegetative growth characteristics of cv. Sweet Charlie during 2007/2008 seasons.

Treatments		2007/2008						
NPK	Spray	Plant height (cm)	Fresh weight/plant(g)	Dry weight/plant(g)	Number of leaves/plant	Number of crowns/plant	Crown diameter (cm)	Leaf area(cm^2)
75%		15.90	52.68	13.09	23.19	2.45	2.39	508.19
100%		16.73	56.82	13.94	24.77	2.45	2.45	522.71
125%		17.54	60.62	14.97	26.37	2.83	2.60	534.78
LSD at 0.5%		0.56	5.039	0.55	1.57	N.S	0.15	20.33
	Control	15.96	49.35	12.21	22.22	2.22	2.19	486.52
	Hammer® 1g/l	16.76	56.03	13.93	24.94	2.51	2.43	515.23
	Hammer® 2g/l	16.86	58.50	14.65	23.67	2.64	2.58	533.79
	Pepton® 0.5g/l	16.92	57.54	14.26	25.80	2.61	2.48	531.97
	Pepton® 1g/l	17.11	62.12	14.94	27.25	2.91	2.71	541.95
LSD at 0.5%		0.72	3.26	1.02	2.51	0.38	0.22	21.67
75%	Control	15.00	44.28	11.74	20.67	2.17	2.13	452.34
	Hammer® 1g/l	16.07	52.50	13.15	24.00	2.50	2.35	509.04
	Hammer® 2g/l	16.18	53.93	13.54	23.00	2.50	2.50	523.08
	Pepton® 0.5g/l	16.03	53.29	13.29	23.99	2.50	2.40	522.09
	Pepton® 1g/l	16.20	59.41	13.73	24.33	2.60	2.60	534.42
100%	Control	15.93	48.17	12.29	21.25	2.17	2.16	490.72
	Hammer® 1g/l	16.77	56.65	14.09	24.50	2.27	2.47	517.27
	Hammer® 2g/l	16.83	59.20	14.42	23.17	2.55	2.55	535.90
	Pepton® 0.5g/l	16.97	57.88	14.35	26.67	2.50	2.48	531.72
	Pepton® 1g/l	17.15	62.21	14.54	28.25	2.78	2.58	537.92
125%	Control	16.95	55.61	12.60	24.75	2.33	2.30	516.50
	Hammer® 1g/l	17.45	58.93	14.54	26.33	2.75	2.48	519.37
	Hammer® 2g/l	17.56	62.36	15.99	24.83	2.87	2.69	542.41
	Pepton® 0.5g/l	17.77	61.45	15.16	26.75	2.83	2.55	542.10
	Pepton® 1g/l	17.96	64.75	16.55	29.17	3.37	2.95	553.52
LSD at 0.5%		1.24	5.66	1.77	4.35	0.65	0.38	37.53

Table (2): Effect of fertgation using NPK mineral fertilizers and foliar spray with organic compounds as well as their interaction on vegetative growth characteristics of cv. Sweet Charlie during 2008/2009 seasons.

Treatments		20082009						
NPK	Spray	Plant height (cm)	Fresh weight/plant(g)	Dry weight/plant(g)	Number of leaves/plant	Number of crowns/plant	Crown diameter (cm)	Leaf area(cm^2)
75%		18.20	68.94	14.27	25.54	2.63	2.50	498.72
100%		19.93	70.75	14.45	27.32	2.72	2.57	523.15
125%		20.79	71.77	15.48	29.77	3.33	2.61	538.59
LSD at 0.5%		0.86	2.22	0.51	1.69	0.32	N.S	18.11
	Control	18.68	61.58	13.13	24.39	2.41	2.41	486.62
	Hammer® 1g/l	19.39	68.48	14.42	26.82	2.78	2.55	516.50
	Hammer® 2g/l	19.79	73.89	15.19	26.39	3.00	2.61	530.07
	Pepton®0.5g/l	20.10	73.23	15.32	28.78	3.06	2.58	527.27
	Pepton® 1g/l	20.23	75.25	15.61	31.34	3.23	2.65	540.31
LSD at 0.5%		0.57	2.64	0.70	2.53	0.48	N.S	18.01
75%	Control	17.48	59.82	13.06	22.50	2.40	2.30	447.70
	Hammer® 1g/l	17.83	66.69	14.05	24.61	2.50	2.50	501.33
	Hammer® 2g/l	18.05	72.56	14.74	25.67	2.67	2.57	513.87
	Pepton®0.5g/l	18.94	72.13	14.69	26.50	2.75	2.53	512.67
	Pepton® 1g/l	18.72	73.49	14.79	28.44	2.83	2.60	518.03
100%	Control	18.48	61.79	12.90	23.66	2.33	2.43	492.77
	Hammer® 1g/l	19.80	69.32	14.07	27.33	2.67	2.57	518.60
	Hammer® 2g/l	20.33	73.50	14.92	25.17	2.83	2.60	533.00
	Pepton®0.5g/l	20.35	72.97	14.85	28.83	2.75	2.60	525.07
	Pepton® 1g/l	20.68	76.17	15.50	31.58	3.03	2.65	546.30
125%	Control	20.08	63.12	13.42	27.00	2.50	2.52	519.40
	Hammer® 1g/l	20.53	69.42	15.14	28.50	3.17	2.58	529.57
	Hammer® 2g/l	21.00	75.62	15.91	28.33	3.50	2.65	543.33
	Pepton®0.5g/l	21.03	74.60	16.43	31.00	3.67	2.60	544.07
	Pepton® 1g/l	21.30	76.07	16.52	33.99	3.83	2.70	556.60
LSD at 0.5%		0.99	4.58	1.22	4.39	0.83	N.S	31.19

dose or decreasing the amounts by 25 % of decided amounts. In addition, no significant differences were found between the application of fertilizers at 100% or 75% of the recommended dose during both seasons of growth. In this connection, such increments in all studied growth parameters as a result of increasing the amounts of mineral fertilizers to 125% of the recommended dose may be attributed to the main role of macro-martinets (N, P and K) on formation of protoplasmic material, cells division and elongations bio– chemicals interaction which affect the rate of plant growth. In this regard, **Albregts and Howard (1987), Albregts and Howard (1991), Mohamed and El Miniawy (2001), El- Sayed (2004), Abo Sedera *et al.*,(2009)** and **Ulvi Morr *et al.*, (2009)** all working on strawberry indicated that plant growth traits were increased with the application of N P and K mineral fertilizers at tested rates.

b. Effected of natural compounds.

Data indicated in Tables (1 and 2) reveal that spraying strawberry plants with Hammer at 1 and 2g /l as a source of humic acid and Pepton at 0.5 and 1g/l as source of amino acids six times starting twenty days after transplanting and every ten days by intervals significantly increased plant vegetative growth expressed as plant height, number of leaves and crowns per plant as well as average leaf area, crown diameter, fresh and dry weight per plant compared with the control treatment . However, no significant difference were detected among the used organic substance in all measured growth traits except in case of the highest rate of pepton (1g/l) which was superior in this regard .Obtained results are similar during the two seasons of growth.

Such increases in growth aspects due to spray of tested organic substances (Hammer and Pepton) may be due to the role of Hammer as source of humic and folvic acids which affected on enzymes activities which in turn affect on marco – nutrient absorption and assimilation and consequently increased plant growth. Also, the effect of Pepton as a source of amino acids which play an important role in plant metapolism and protein assimilation which necessary for cells formation and consequently increased fresh and dry matter of plant which are good indicator for plant growth. In this connection.**Albregts *et al.*, (1988), Arancon *et al.*, (2003), Talaat (2003)** on strawberry **and El-Zohiri and Asfor (2009)** on potato **and El-Zohiri and Abdou (2009)** on garlic reported similar results on tested vegetable crops.

c. Effect of the interaction.

Data recorded in Tables (1 and 2) show clearly that application of mineral fertilizer at the highest used level (125% of recommended dose) and spray the plants six times starting after twenty days of transplanting and every ten days intervals with Pepton at.1g/liter exhibited the highest values in all measured growth parameters during both seasons of study. However, no significant differences were noticed in most of plant measurements among the other studied interaction treatments under the same level of fertilization.

4.1.2. Chemical constituents of plant foliage.

Data in Table (3) show the effect of mineral fertilizer (NPK) and natural compounds foliar spray as well as their interaction on total nitrogen, phosphorus and potassium as well

Table (3): Effect of fertgation using NPK mineral fertilizers and foliar spray with organic compounds as well as their interaction on chemical constituents of plant foliage of cv. Sweet Charlie during two seasons study.

Treatments		2007/2008				2008/2009			
NPK	Spray	N (mg/100g d.w)	P (mg/100g d.w)	K (mg/100g d.w)	Carbohydrates (g/100g d.w)	N (mg/100g d.w)	P (mg/100g d.w)	K (mg/100g d.w)	Carbohydrates (g/100g d.w)
75%		2493	413	1416	10.12	2533	431	1525	10.29
100%		2617	435	1441	10.38	2571	443	1563	10.32
125%		2665	447	1613	10.42	2727	457	1652	10.77
LSD at 0.5%		111	13	165	0.16	91	16	98	0.42
	Control	2418	410	1401	9.44	2504	421	1503	9.54
	Hammer® 1g/l	2551	420	1448	10.34	2553	434	1542	10.47
	Hammer® 2g/l	2656	443	1527	10.53	2667	453	1611	10.76
	Pepton®0.5g/l	2616	432	1493	10.45	2589	444	1603	10.63
	Pepton® 1g/l	2719	454	1581	10.79	2737	467	1639	10.93
LSD at 0.5%		140	16	N.S	0.59	112	17	N.S	0.53
75%	Control	2360	390	1337	8.99	2433	407	1470	9.59
	Hammer® 1g/l	2487	403	1373	10.33	2487	420	1500	10.43
	Hammer® 2g/l	2533	427	1447	10.47	2577	443	1550	10.44
	Pepton®0.5g/l	2500	410	1430	10.35	2510	433	1513	10.25
	Pepton® 1g/l	2587	437	1493	10.48	2660	453	1590	10.77
100%	Control	2447	423	1360	9.91	2483	423	1457	9.39
	Hammer® 1g/l	2570	430	1397	10.33	2500	433	1500	10.25
	Hammer® 2g/l	2667	440	1463	10.53	2647	447	1587	10.68
	Pepton®0.5g/l	2650	433	1430	10.50	2510	443	1647	10.50
	Pepton® 1g/l	2753	450	1553	10.62	2713	470	1623	10.80
125%	Control	2447	417	1507	9.41	2597	433	1583	9.63
	Hammer® 1g/l	2597	427	1573	10.35	2673	450	1627	10.73
	Hammer® 2g/l	2767	463	1670	10.59	2780	470	1697	11.15
	Pepton®0.5g/l	2697	453	1620	10.51	2747	457	1650	11.14
	Peptone® 1g/l	2817	477	1697	11.26	2837	477	1703	11.23
LSD at 0.5%		243	27	N.S	1.01	194	30	N.S	0.93

as total carbohydrates content of plant foliage during the two seasons of growth.

a. Effect of mineral fertilizers.

Data recorded in Table (3) show clearly that total nitrogen, phosphorus, potassium and total carbohydrates were significantly different as a result of the tested amounts of mineral fertilizer during both seasons of study. In this connection, application of mineral fertilizers at 125% of the recommended dose (200 kg N + 80 kg P_2O_5+ 240 kg K_2O/ fed.) reflected the highest value in all assayed chemical constituents compared with using mineral fertilizers at the recommended dose or at 75% of it during the two seasons of study . In addition no significant difference in all determined chemical constituent among the treatment which supplied with the recommended dose of mineral fertilizers and that treatment which contained 75 % of the recommended amount of used NPK fertilizers. Such increments in N, P and K content as a result of increments in increasing the amounts of added mineral fertilizers may be due to the increase of such nutrient in roots biosphere and consequently increases its uptake and accumulation of such macro- nutrients Also the increase in total carbohydrate content might attributed to the main role of used macro- nutrients (NPK) as constituents of photosynthetic pigment molecules and assimilation rate for precursors of carbohydrates in leaves. **Cutcliffe and Blatt (1984), El- Oksh *et al.*, (1987), Haynes and Goh (1987), Castelane *et al.*, (1993) , Kaponski and Kawecki (1994), Mass *et al.*, (1997), Mohamed and El Miniawy (2001), Eissa (2002) Abd El- Aziz (2007), and Abo Sedera *et al.*,(2009)** all working

on strawberry reported significant increments in all determined chemical constituents as a result of using NPK fertilizers at different rates.

b. Effect of natural compounds.

Data presented in Table (3) indicate that spraying strawberry plants six times during the growing season with Hammer at 1 and 2 g/liter and Pepton at 0.5 and 1.0g/liter significantly increased total nitrogen phosphorus, potassium and total carbohydrates content in plant foliage compared to the control treatment. In addition, the highest values in all determined chemical constituents were recorded in case of using Hammer and Pepton at the higher rates (1 and 2g/liter) for Hammer and Pepton, respectively without significant difference among them. Such results are true during both seasons of study. In this respect, the increments in macro nutrient and carbohydrates as a result of using Hammer and Pepton may be attributed to the role of such compounds in increasing the availability of macro- nutrients to plant absorption and or increasing the passive force in plants required for nutrient elements absorption and consequently increased its content in plant foliage, furthermore, such tested organic compound play a positive role on carbohydrates assimilation through the photosynthetic process and consequently increased plant foliage. In this regard, total nitrogen, phosphours and potassium of plant foliage were positively affected as a result of using humic acid, Pepton and Mega power **(Pilanal and Kaplan, 2003** on strawberry**, and El-Zohiri and Abdiu, (2009) on Garlic).**

c. Effect of the interaction.

As for the effect of the interaction between mineral fertilizers and organic compounds, the same data in Table (3) clearly show that, application of mineral fertilizers (NPK) at rate of 125% of recommended dose (250 Kg N + 100 kg $P_2 O_5$ + 300 kg K_2O/fed.) and spraying the plants with the higher concentration of Hammer or Pepton reflected the highest values in all assayed chemical constituents during the two seasons of growth.

4.1.3.Fruit yield and its components

Date recorded in Table (4 and 5) indicated the effect of mineral fertilizers (NPK) and organic compounds application as well as their interaction on produced fruit yield and its components during 2007 / 2008 and 2008/ 2009 seasons.

a. Effect of mineral fertilizers

Data recorded in Tables (4 and 5) show that total produced yield and its components expressed as early, exportable and marketable yield per plant and feddan were significantly affected by the application of mineral fertilizers (NPK) at the recommended dose or at 125 % and 75 % of it during both seasons of study. In this respect, application mineral fertilizers (NPK) at 125% of the recommended dose (200kg N, 80kg $P_2 O_5$ and 240 kg K_2 O/fed.) exhibited the highest values for total produced yield and its components followed by treatment fertilized by 100% of recommended dose and 75 % in descending order, However, no significant differences were noticed between treatments in which the plants fertilized with mineral fertilizers at 100% and 75% of the recommended dose

Table (4): Effect of fertgation using NPK mineral fertilizers and foliar spray with organic compounds as well as their interaction on total fruit yield and its components of cv. Sweet Charlie during 2007/2008 season.

Treatments		2007/2008					
NPK	Spray	Early yield (ton/fed)	Exportable yield(ton/fed)	Marketable yield (ton/fed)	Total yield(g/plant)	Total yield(t/fed)	Unmarketable yield(kg/fed)
75%		2.998	1.685	20.374	459.56	20.680	306.45
100%		3.092	1.531	21.507	487.98	21.813	306.10
125%		3.629	2.212	22.281	501.97	22.588	307.98
LSD at 0.5%		0.285	0.144	0.354	7.94	0.357	N.S
	Control	2.747	1.606	18.929	428.92	19.301	372.30
	Hammer® 1g/l	3.168	1.819	20.012	452.57	20.367	354.50
	Hammer® 2g/l	3.096	1.634	22.236	501.51	22.568	332.25
	Pepton®0.5g/l	3.663	1.976	22.421	506.73	22.802	381.75
	Peptone® 1g/l	3.523	2.011	23.338	526.11	23.675	336.75
LSD at 0.5%		0.248	0.292	0.615	13.90	0.626	N.S
75%	Control	2.475	1.478	18.440	415.37	18.690	249.75
	Hammer® 1g/l	2.738	1.585	19.641	443.65	19.965	324.00
	Hammer® 2g/l	2.983	1.533	21.344	481.07	21.650	306.00
	Pepton®0.5g/l	3.253	2.223	20.836	471.88	21.232	396.00
	Peptone® 1g/l	3.540	1.605	21.606	485.80	21.863	256.50
100%	Control	2.538	1.418	18.476	426.35	18.883	408.75
	Hammer® 1g/l	2.900	1.400	19.939	452.75	20.375	435.75
	Hammer® 2g/l	3.030	1.535	22.170	500.05	22.505	335.25
	Pepton®0.5g/l	3.355	1.528	23.295	527.28	23.728	432.00
	Peptone® 1g/l	3.635	1.775	23.656	533.48	24.005	348.75
125%	Control	3.228	1.923	19.869	445.05	20.027	158.40
	Hammer® 1g/l	3.868	2.473	20.456	461.30	20.760	303.75
	Hammer® 2g/l	3.275	1.835	23.194	523.40	23.550	355.50
	Pepton®0.5g/l	3.960	2.283	23.130	521.05	23.448	317.25
	Peptone® 1g/l	3.813	2.548	24.753	559.05	25.157	405.00
LSD at 0.5%		0.43	0.506	1.065	24.08	1.083	N.S.

Table (5): Effect of fertgation using NPK mineral fertilizers and foliar spray with organic compounds as well as their interaction on total fruit yield and its components of cv. Sweet Charlie during 2008/2009 season.

Treatments		2008/2009					
NPK	Spray	Early yield(ton/fed)	Exportable yield(ton/fed)	Marketable yield (ton/fed)	Total yield(g/plant)	Total yield(t/fed)	Unmarketable yield(kg/fed)
75%		4.629	2.190	21.533	486.28	21.884	350.00
100%		4.742	2.009	21.959	495.80	22.310	351.12
125%		5.558	2.467	24.139	544.58	24.506	366.80
LSD at 0.5%		0.374	0.132	0.958	21.141	0.950	N.S
	Control	3.837	1.978	20.917	472.65	21.268	350.93
	Hammer® 1g/l	4.822	2.151	21.953	496.40	22.339	386.40
	Hammer® 2g/l	5.025	2.188	23.339	525.88	23.665	325.73
	Pepton®0.5g/l	5.702	2.374	22.711	511.57	23.021	309.40
	Peptone® 1g/l	5.494	2.418	23.799	537.93	24.207	407.40
LSD at 0.5%		0.333	0.214	0.803	18.039	0.8121	N.S
75%	Control	3.315	1.963	20.092	455.05	20.477	385.00
	Hammer® 1g/l	4.450	2.108	21.545	487.28	21.930	385.00
	Hammer® 2g/l	4.898	2.193	22.031	495.85	22.315	284.20
	Pepton®0.5g/l	5.165	2.388	21.964	493.75	22.217	253.40
	Peptone® 1g/l	5.315	2.298	22.035	499.48	22.478	442.40
100%	Control	3.825	1.793	20.281	457.20	20.572	291.20
	Hammer® 1g/l	4.273	1.828	21.323	482.38	21.708	385.00
	Hammer® 2g/l	4.913	1.923	22.655	511.48	23.015	359.80
	Pepton®0.5g/l	5.288	2.233	21.964	494.90	22.272	308.00
	Peptone® 1g/l	5.410	2.270	23.716	536.20	24.128	411.60
125%	Control	4.370	2.180	22.378	505.70	22.755	376.60
	Hammer® 1g/l	5.743	2.518	22.991	519.55	23.38	389.20
	Hammer® 2g/l	5.265	2.450	25.332	570.33	25.665	333.20
	Pepton®0.5g/l	6.653	2.503	24.348	549.20	24.715	366.80
	Peptone® 1g/l	5.758	2.685	25.647	578.13	26.015	368.20
LSD at 0.5%		0.577	0.371	1.564	31.244	1.407	N.S

except in case of marketable yield during both seasons where treatment of 100% was superior than 75% of commended dose during the two seasons of study.

In this regard, the higher total produced yield and its components in case of using the higher level of mineral fertilizer (125%) were connected with the increase in vegetative growth rate Tables (3 and 4) and fruit physical parameters (Table 6) which in turn affect the total fruit yield . in this connection. **Albregt *et al.*, (1991a), Castellane *et al* (1993), Kara (1996), Lamarre and Lareau (1997), Arancon *et al* (2003), Abd El-Aziz (2007) And Ulvi Morr *et al.*, (2009)** indicated that total fruit yield and its components were enhanced as a result of application minerals (NPK) fertilizers.

b. Effect of natural compounds.

Concerning the effect of spray with organic compounds i.e. Hammer and Pepton on total produced fruit yield and its components, the same data in Tables (4 and 5) reveal that spraying the plants six times during the growing seasons starting at 20 days from transplanting and every 10 days intervals with Pepton as a source of amino acid at rate of 0.5 and 1.0 g/liter. exhibited the highest values in all determined yield parameters compared with other studied spray treatments especially during the first season . However, the highest level of both Pepton and Hammer were exhibited the highest values in this regard. Moreover no significant difference were recorded in case of the unmarketable fruit yield among all tested spray treatments and the control one, such increments in total produced yield and its components were connected with the increase in vegetative

growth Tables (1 and 2) which in turn affect the produce ability of plants. In this concern, **Albregts *et al.*, (1988), Pilanal and Kaplan (2000), Neri *et al.*, (2002),** and **Arancon *et al.*, (2003),** on strawberry **and Ahmed (2003), Neeraje *et al.*, (2005) and Morad and Morad (2006)** and **Shafshak *et al.*,(2008)** on tomato indicated that using tested organic compounds reflected the higher values in total fruit yield and its components expressed as number of fruits, early and produced yield per urea.

c. Effect of the interaction

With regard to the effect of the interaction between mineral fertilization treatments and spray with organic compounds the same data in Tables (4 and 5) reveal that using the highest rate (125%) of (N PK) fertilizers and spaying the plants with the higher level of Pepton (1.0 g/liter) reflected the highest values except in case of early yield which was positively highest by using Peptone at 0.5 g/liter. during the two seasons of study.

4.1.4. Physical fruit quality

Data recorded in Table (6) indicate the effect of mineral fertilizers and organic compound spray as well as their interaction on physical fruit quality of strawberry during 2007/2008 and 2008/ 2009 seasons.

a. Effect of mineral fertilizers

Data in Table (6) show that fertilizing strawberry plant with mineral fertilizers (NPK) at the recommended dose, i.e., 200 kg N+80 kg P_2O_5 + 240kg K_2O/ fed or either increasing the rate of application up to 125% or decreasing to 75% of the recommend dose significantly affected all the measured physical

Table (6): Effect of fertgation using NPK mineral fertilizers and foliar spray with organic compounds as well as their interaction on physical fruit quality of cv. Sweet Charlie during the two seasons of study.

Treatments		2007/2008				2008/2009			
NPK	Spray	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit firmness(g/cm^2)	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit firmness (g/cm^2)
75%		16.76	4.41	3.35	60.00	17.25	4.42	3.43	65.80
100%		17.15	4.40	3.39	60.15	17.86	4.43	3.54	68.50
125%		17.25	4.48	3.46	61.35	18.25	4.49	3.64	69.70
LSD at 0.5%		0.39	0.09	0.05	N.S	0.80	0.07	0.12	N.S
	Control	16.00	4.31	3.28	55.67	15.94	4.30	3.43	64.08
	Hammer® 1g/l	17.13	4.40	3.37	61.42	17.80	4.44	3.51	68.33
	Hammer® 2g/l	17.52	4.47	3.44	60.25	18.30	4.49	3.55	67.67
	Pepton®0.5g/l	16.85	4.46	3.43	62.00	18.01	4.47	3.53	69.75
	Peptone® 1g/l	17.77	4.52	3.48	63.17	18.86	4.55	3.67	70.17
LSD at 0.5%		0.44	0.13	0.10	2.58	0.525	0.08	0.13	4.72
75%	Control	15.70	4.31	3.33	51.50	15.03	4.30	3.24	63.25
	Hammer® 1g/l	16.98	4.41	3.35	62.00	17.55	4.41	3.42	63.50
	Hammer® 2g/l	17.10	4.45	3.39	60.00	17.58	4.45	3.46	64.50
	Pepton®0.5g/l	16.73	4.45	3.38	64.00	17.33	4.44	3.44	71.25
	Peptone® 1g/l	17.30	4.47	3.41	62.50	18.75	4.49	3.48	66.50
100%	Control	15.90	4.26	3.27	55.75	16.18	4.26	3.46	66.75
	Hammer® 1g/l	17.08	4.34	3.37	60.00	17.90	4.45	3.53	69.25
	Hammer® 2g/l	17.80	4.45	3.42	62.50	18.40	4.48	3.57	70.50
	Pepton®0.5g/l	16.70	4.43	3.40	61.25	17.93	4.46	3.55	67.75
	Peptone® 1g/l	18.25	4.50	3.48	61.25	18.88	4.53	3.61	68.25
125%	Control	16.40	4.35	3.34	59.75	16.63	4.35	3.49	62.25
	Hammer® 1g/l	17.33	4.47	3.40	62.25	17.95	4.46	3.58	72.25
	Hammer® 2g/l	17.65	4.52	3.52	58.25	18.93	4.54	3.62	68.00
	Pepton®0.5g/l	17.13	4.49	3.50	60.75	18.78	4.51	3.60	70.25
	Peptone® 1g/l	17.75	4.58	3.55	65.75	18.95	4.63	3.92	75.75
LSD at 0.5%		0.76	0.22	0.18	4.47	0.91	0.15	0.22	8.17

fruit quality characters (average fruit length, diameter and weight) except fruit firmness which was not significantly affected. In this concern, application of mineral fertilizers (N P K) at 125% of the recommended dose exhibited the highest values for all measured fruit quality traits. In addition no significant differences were recorded in studied physical fruit quality parameter as a result of using the recommended dose and 75% of it. In this concept. Increasing the tested physical fruit quality as a result of increasing the rate of NPK fertilizers up to 125% of recommended rate my be attributed to such macro-nutrients are necessary to cells formation and division as well as increasing rates of photosynthetic assimilates and migration of it to storage organs (fruit) and in turn increase its parameters. In this regard. **Barrventos (1982),** and **Abo- El- Hamed *et al.* (2006)** reported that application of nitrogen and potassium fertilizers increased physical fruit quality expressed as fruit length, diameter and size. However, **Abd El-Aziz (2007)** indicated that application of mineral fertilizers did not affect physical fruit quality.

b. Effect of natural compounds.

Regarding the effect of organic compounds on physical fruit quality the same date in Table (6) reveal that averages fruit weight, length, diameter and fruit firmness were significantly affected due to spraying the plants with both Pepton and Hammer at different tested concentration compared with the control treatment. In this respect, spraying the plants with Pepton as a source of amino acids at 1g/liter was ranked first followed by Hammer as a source of humic acid at 2 g/liter without

significant difference among them. Obtained results are true during both seasons of study. Similar results were recorded by **Ertan Yildirim (2007) and Shafshak *et al.*, (2008)** on tomato.

c. Effect of the interaction

As for the effect of the interaction the same data in Table (6) reveal that supplying the plants with mineral fertilizer at rate of 125% of the recommended dose combined with spraying the plants six times with the higher level of pepton 1.0g/liter as a source of amino acid reflected the highest values of all determined physical fruit traits during both seasons of study.

4.1.5. Chemical fruits quality.

Data presented in Tables (7 and 8) indicate the effect of mineral fertilization and spray with organic compounds as well as their combination on chemical fruit quality of strawberry during 2007/2008 and 2008/ 2009 seasons.

a. Effect of mineral fertilization:

Date recorded in Tables (7 and 8) indicate that fertilizing the plants with mineral fertilizer (N P K) at the recommended dose or either increasing the rate of application to 125% or decreasing it to 75% of the recommended dose significantly affected vitamin C total acidity and anthocyanine content during the first season and vitamin C, reducing and total sugars as well as anthocyanine pigments content during the second season. However, it did not affect T.S.S, reducing sugars and total acidity during the second season In this respected, the highest level of mineral (N P K) fertilizers (125% of recommended dose) recorded the highest values in all assayed chemical constituents during both seasons of study. Moreover, no significant

Table (7): Effect of fertgation using NPK mineral fertilizers and foliar spray with organic compounds as well as their interaction on chemical constituents in fruits of cv. Sweet Charlie during 2007/2008 season.

Treatments		2007/2008					
NPK	Spray	TSS%	Vit.C (mg/100g f.w)	Acidty (mg/100g f.w)	Total sugars%	Reducing sugars%	Anthocyanin (mg/100g f.w)
75%		10.11	52.85	0.54	7.48	4.27	78.81
100%		10.24	53.67	0.52	7.52	4.32	78.83
125%		10.87	54.05	0.50	7.59	4.39	81.21
LSD at 0.5%		N.S	1.13	0.03	N.S	N.S	0.53
	Control	9.267	50.69	0.59	7.35	3.35	75.27
	Hammer® 1g/l	10.59	53.67	0.49	7.53	4.54	80.73
	Hammer® 2g/l	10.48	54.17	0.52	7.49	4.49	80.67
	Pepton®0.5g/l	10.75	54.17	0.50	7.61	4.61	80.95
	Peptone® 1g/l	10.95	54.92	0.50	7.66	4.65	81.80
LSD at 0.5%		0.54	1.63	0.06	0.15	0.12	0.45
75%	Control	9.15	50.50	0.61	7.29	3.29	74.69
	Hammer® 1g/l	9.60	52.00	0.52	7.49	4.50	80.53
	Hammer® 2g/l	10.25	54.5	0.54	7.46	4.46	80.63
	Pepton®0.5g/l	10.70	53.25	0.5	7.56	4.55	80.81
	Peptone® 1g/l	10.85	54.00	0.51	7.58	4.57	81.40
100%	Control	9.05	50.33	0.59	7.30	3.32	70.75
	Hammer® 1g/l	10.98	54.00	0.48	7.52	4.53	80.47
	Hammer® 2g/l	10.28	54.50	0.53	7.48	4.50	80.64
	Pepton®0.5g/l	10.35	54.75	0.49	7.59	4.61	80.58
	Peptone® 1g/l	10.55	54.75	0.52	7.68	4.65	81.70
125%	Control	9.60	51.25	0.56	7.44	3.44	80.39
	Hammer® 1g/l	11.20	55.00	0.47	7.58	4.59	81.19
	Hammer® 2g/l	10.90	53.50	0.49	7.52	4.50	80.72
	Pepton®0.5g/l	11.20	54.50	0.50	7.67	4.66	81.45
	Peptone® 1g/l	11.45	56.00	0.46	7.73	4.74	82.29
LSD at 0.5%		0.94	2.83	0.1	0.25	0.20	0.77

Table (8): Effect of fertgation using NPK mineral fertilizers and foliar spray with organic compounds as well as their interaction on chemical constituents in fruits of cv. Sweet Charlie during 2008/2009 season.

Treatments		2008/2009					
NPK	Spray	TSS%	Vit.C (mg/100g f.w)	Acidty (mg/100g f.w)	Total sugars %	Reducing sugars%	Anthocyanin (mg/100g f.w)
75%		10.41	53.60	0.51	7.52	4.32	79.80
100%		10.71	53.45	0.53	7.55	4.35	79.86
125%		10.82	55.85	0.52	7.64	4.44	81.24
LSD at 0.5%		N.S	2.49	N.S	0.09	0.09	1.30
	Control	9.70	52.00	0.56	7.43	3.44	77.17
	Hammer® 1g/l	10.93	54.08	0.51	7.60	4.58	80.74
	Hammer® 2g/l	10.48	54.00	0.53	7.54	4.54	80.74
	Pepton®0.5g/l	11.03	55.17	0.51	7.61	4.62	80.90
	Peptone® 1g/l	11.09	56.25	0.51	7.66	4.67	81.96
LSD at 0.5%		0.49	2.287	0.03	0.17	0.16	1.34
75%	Control	9.80	50.25	0.57	7.37	3.36	75.56
	Hammer® 1g/l	10.40	53.50	0.49	7.59	4.54	80.46
	Hammer® 2g/l	10.15	55.25	0.49	7.48	4.48	80.70
	Pepton®0.5g/l	10.95	54.00	0.50	7.53	4.59	80.80
	Peptone® 1g/l	10.75	55.00	0.52	7.62	4.63	81.51
100%	Control	9.48	51.25	0.56	7.42	3.43	75.61
	Hammer® 1g/l	11.13	53.75	0.53	7.57	4.56	80.50
	Hammer® 2g/l	11.00	53.50	0.53	7.51	4.52	80.74
	Pepton®0.5g/l	10.85	53.75	0.51	7.61	4.6	80.65
	Peptone® 1g/l	11.10	55.00	0.53	7.66	4.67	81.80
125%	Control	9.83	54.50	0.54	7.52	3.53	80.33
	Hammer® 1g/l	11.25	55.00	0.51	7.64	4.65	81.25
	Hammer® 2g/l	10.28	53.25	0.56	7.62	4.62	80.79
	Pepton®0.5g/l	11.30	57.75	0.52	7.69	4.68	81.27
	Peptone® 1g/l	11.43	58.75	0.49	7.71	4.72	82.57
LSD at 0.5%		0.85	3.961	0.05	0.29	0.28	2.33

differences were found between using mineral fertilizers at the recommended dose and that contained the mineral fertilizers at 75% of it in all chemical constituent traits.

b. Effect of natural compounds.

Date present in Table (7 and 8) show that total soluble solids (T.S.S), vitamin C, total acidity, reducing and total sugars as well as anthocyanine content of fruit were significantly affected due to spraying the plants with either Hammer at 1 and 2 g/liter or Pepton at 0.5 and 1.0 g/liter compared with the control treatments. In this connection, the highest value in all determined chemical constituents were recorded in case of spraying the plants with peptone compound at its various level followed by using Hammer at higher level (2g/liter) except the total acidity which was higher in case of the control treatment. Obtained results were true during both season of study.

c. Effect of the interaction

As for the effect of the interaction the same data in Table (7 and 8) show that the highest values in all studied chemical fruit quality traits except total titratable acidity, were recorded as result of application the highest rate of mineral fertilizer (125% of recommended dose) and spray the plants with Peptone at 1g/liter compared with the other interaction treatments. Obtained results are true during both seasons of study.

4.2. Second experiments: Effect of foliar spray with mineral salts on growth, yield and quality of fruits for some strawberry cultivars.

4.2.1. Vegetative growth characteristics:

Data presented in Tables (9 and 10) show the effect of tested cultivars and spray with mineral salts i.e., calcium chlorides, calcium nitrate, potassium nitrate and mono potassium phosphate as well as their combination on vegetative growth parameters of strawberry plants, (plant height, number of leaves and crown per plant, crown diameter, average leaf area, fresh and dry weight per plant) during the two seasons of study.

a. Effect of cultivar:

Data in Tables (9 and 10) indicate that there were significant differences in most studied morphological parameters of strawberry plants among the tested cultivars during both seasons of growth. In this regard, cv. Festival reflected the highest values in all measured growth traits i.e. plant height, number of leaves and crown per plant, crown diameter, average leaf area as well as fresh and dry weight of plant. compared with cv. Sweet Charlie. In addition, such increments did not reach the level of significant in case of plant height, number of leave and crowns/ plant, crown diameter and dry weight during the first season and crow diameter during the second one. Such differences in growth aspects among the used cultivars may be attributed to the difference in genetic potential. Obtained results are in agreement with those reported by **Strik and proctor (1998), Ragab *et al.*, (2000), Ilgin and Kasava (2002), Mohamed (2003) and Ahmed (2009)** on strawberry indicated

Table (9): Effect of cultivars and spray with calcium and potassium salts as well as their interaction on vegetative growth characteristics of strawberry plants during 2007-2008 season.

Treatments		2007/2008						
CV	Spray	Plant height (cm)	Fresh weight/plant (g)	Dry weight/plant (g)	Number of Leaves/plant	Number of crowns/plant	Crown diameter (cm)	Leaf area(cm^2)
Sweet Charlie		19.24	53.89	12.00	21.23	2.42	2.61	351.85
Festival		21.29	56.64	12.57	21.41	2.46	2.56	399.17
L.S.D .at 0.05%		N.S	8.04	N.S	N.S	N.S	N.S	27.93
	Control	18.050	48.86	11.09	18.75	2.03	2.29	317.53
	Calcium Colorid (0.5%)	19.88	55.05	12.08	20.58	2.15	2.49	365.98
	Calcium nitrat (1%)	20.59	56.28	12.20	21.33	2.50	2.63	381.96
	potassium nitrat (1.5%)	21.73	57.45	12.49	22.33	2.58	2.65	397.60
	Mono potassium phosphate(1%)	21.06	58.68	13.55	23.62	2.93	2.84	414.48
L.S.D .at 0.05%		1.80	4.32	1.60	1.79	0.65	0.29	19.65
Sweet Charlie	Control	16.27	47.77	10.30	18.99	1.99	2.42	289.36
	Calcium Colorid (0.5%)	19.10	54.30	12.05	20.00	2.06	2.57	356.37
	Calcium nitrat (1%)	19.92	54.51	12.01	20.99	2.50	2.62	354.65
	potassium nitrat (1.5%)	20.97	55.59	12.31	22.66	2.66	2.62	373.80
	Mono potassium phosphate(1%)	19.92	57.29	13.32	23.50	2.86	2.80	385.07
Festival	Control	19.82	49.95	11.89	18.50	2.06	2.15	345.70
	Calcium Colorid (0.5%)	20.66	55.79	12.11	21.16	2.24	2.41	375.59
	Calcium nitrat (1%)	21.27	58.05	12.40	21.67	2.50	2.65	409.27
	potassium nitrat (1.5%)	22.50	59.32	12.68	22.00	2.50	2.68	421.40
	Mono potassium phosphate(1%)	22.19	60.08	13.79	23.75	2.99	2.88	443.88
L.S.D .at 0.05%		2.54	6.11	2.27	2.54	0.91	0.41	27.79

Table (10): Effect of cultivars and spray with calcium and potassium salts as well as their interaction on vegetative growth characteristics of strawberry plants during 2008-2009 season.

Treatments		2008/2009						
CV	Spray	Plant height (cm)	Fresh weight/plant(g)	Dry weight/plant(g)	Number of Leaves/plant	Number of crowns/plant	Crown diameter (cm)	Leaf area(cm^2)
Sweet Charlie		17.76	50.17	12.61	19.41	2.33	2.42	414.80
Festival		19.85	60.27	15.51	21.95	2.68	2.62	537.66
L.S.D .at 0.05%		0.69	3.46	1.86	1.29	0.32	N.S	14.73
	Control	17.73	48.64	11.99	18.62	2.12	2.21	403.42
	Calcium Colorid (0.5%)	18.39	50.53	13.19	19.37	2.41	2.44	451.92
	Calcium nitrat (1%)	18.86	55.02	14.01	20.61	2.46	2.53	462.98
	potassium nitrat (1.5%)	20.06	59.36	15.20	21.65	2.66	2.56	508.26
	Mono potassium phosphate(1%)	18.97	62.54	15.92	23.16	2.87	2.85	554.59
L.S.D .at 0.05%		1.04	3.56	1.33	1.74	0.40	0.37	30.71
Sweet Charle	Control	17.03	46.48	11.19	17.00	2.00	2.21	348.48
	Calcium Colorid (0.5%)	17.25	47.53	11.87	18.00	2.16	2.28	417.01
	Calcium nitrat (1%)	17.61	48.88	11.89	19.22	2.25	2.40	412.33
	potassium nitrat (1.5%)	19.41	51.48	13.71	20.50	2.500	2.42	429.48
	Mono potassium phosphate(1%)	17.50	56.48	14.40	22.33	2.75	2.80	466.71
Festival	Control	18.44	50.80	12.79	20.25	2.25	2.21	458.36
	Calcium Colorid (0.5%)	19.54	53.54	14.51	20.75	2.66	2.61	486.82
	Calcium nitrat (1%)	20.12	61.16	16.13	22.00	2.66	2.67	513.62
	potassium nitrat (1.5%)	20.71	67.25	16.69	22.80	2.83	2.72	587.03
	Mono potassium phosphate(1%)	20.45	68.60	17.44	23.99	3.00	2.90	642.46
L.S.D .at 0.05%		1.47	5.03	1.89	2.47	0.57	0.63	43.43

that there were a differences in most studied growth measurements among the tested cultivars.

b. Effect of mineral salts:

As for the effect of mineral salts i.e., calcium chloride, calcium nitrate, potassium nitrate and mono potassium phosphate on vegetative growth, the same data in Tables (9 and 10) indicate that all the studied growth parameters i.e., plant height, number of leaves and branches per plant, crown diameter, average leaf area and fresh and dry weight of plant were significantly increased during the two seasons of growth as a result of spraying plants six times with the used mineral salts during the growth seasons, starting at the beginning of flowering and every 15 days intervals, compared with the control treatments. In this connection, using mono potassium phosphate at 1.0% exhibited the highest values in all studies growth parameters followed by potassium nitrate at 1.5%, calcium nitrate at 1% calcium chloride at 0.5% in descending order. Obtained results are true during both seasons of growth. Such increments in growth parameters as a result of using potassium mineral salts may be due to the role of such macro-nutrients on physiological process and cell division and elongation which in turn effect on tissues formation and consequently vegetative growth of plant. In this regard, **El-bassiouny (1992), Kaya *et al.* (2003) and Yildirm *et al.* (2009)** on strawberry and **Hewedy *et al* (1994), Ramamoorthy *et al.* (1995) and Badawy *et al.* (2004)** on bean reported similar results.

c. Effect of the interaction:

With regard to the effect of the interaction between the tested cultivars and spraying the plants with studied mineral compounds, on vegetative growth parameter of plant, the some data in Tables (9 and 10) show dearly that spraying the plants of cv. Festival with mono potassium phosphate six times during the growing seasons reflected the highest values in all measured growth traits compared with other interaction treatments during both seasons of study.

4.2.2. Chemical composition of plant foliage:

Data recorded in Table (11) indicate the effect of cultivars, mineral salts as well as their interaction on chemical composition of plant foliage during the two seasons of growth.

a. Effect of cultivars:

Concerning the effect of cultivars on chemical constituents of plant foliage, data in Table (11) indicate that total nitrogen, phosphorus, potassium and total carbohydrates content of plant foliage were differed among the tested cultivars. In this respect, cv. Festival recorded the highest values in all assayed chemical constituents compared with cv Sweet Charlie during both growth seasons. In this respect, **Abd El-Aziz (2007)** indicated that there were significant differences among the studied cultivars in as sayed chemical constituents of plant foliage.

b. Effect of mineral salts:

As for the effect of mineral salts i.e. $CaCl_2$, Ca $(NO_3)_2$, KNO_3 and $KHPO_4$ on chemical constituents of plant foliage, data

Table (11): Effect of cultivars and spray with calcium and potassium salts as well as their interaction on chemical constituents of plant foliage of strawberry plants during tow seasons.

Treatments		2007/2008				2008/2009			
CV	Spray	N (mg/ 100gd.w)	P (mg/ 100gd.w)	K (mg/ 100gd.w)	Carbohydrates (g/ 100 g d.w.)	N (mg/ 100gd.w)	P (mg/ 100gd.w)	K (mg/ 100gd.w)	Carbohydrates (g/ 100 g d.w.)
Sweet Charlie		2490	423	1422	10.37	2458	433	1405	10.51
Festival		2591	431	1591	10.50	2613	445	1611	10.59
L.S.D .at 0.05%		N.S	N.S	N.S	N.S	55	9	198	N.S
	Control	2417	407	1428	10.00	2457	403	1287	10.21
	Calcium Colorid (0.5%)	2477	422	1467	10.50	2487	432	1537	10.54
	Calcium nitrat (1%)	2578	425	1532	10.53	2548	443	1593	10.64
	potassium nitrat (1.5%)	2613	440	1538	10.61	2592	458	1507	10.66
	Mono potassium phosphate(1%)	2617	442	1567	10.61	2595	460	1617	10.70
L.S.D .at 0.05%		126	17	N.S	0.32	125	12	227	0.226
Sweet Charlie	Control	2413	400	1353	9.92	2387	397	1000	10.14
	Calcium Colorid (0.5%)	2470	423	1387	10.40	2433	433	1483	10.50
	Calcium nitrat (1%)	2523	427	1450	10.50	2480	437	1577	10.64
	potassium nitrat (1.5%)	2497	423	1420	10.50	2477	443	1363	10.55
	Mono potassium phosphate(1%)	2546	443	1500	10.60	2513	457	1600	10.70
Festival	Control	2420	413	1503	10.10	2527	410	1573	10.28
	Calcium Colorid (0.5%)	2483	420	1547	10.50	2540	430	1590	10.58
	Calcium nitrat (1%)	2633	423	1613	10.50	2617	450	1610	10.63
	potassium nitrat (1.5%)	2687	440	1633	10.60	2670	460	1633	10.70
	Mono potassium phosphate(1%)	2730	457	1657	10.80	2713	477	1650	10.78
L.S.D .at 0.05%		178	24	234	0.45	177	17	322	0.32

in the same Table show clearly that total nitrogen, phosphorus, potassium and total carbohydrates were significantly increased as a result of a praying the plants with tested mineral salts at different used concentrations compared to the chick treatment. Obtained results were true during both seasons of study. In this connection, the highest values were recorded in case of using potassium mono phosphate, potassium nitrate and calcium nitrate, respectively without significant difference between them. Obtained results may be due to the increase of enzymatic activities which affect on absorption of mineral nutrients by plant and in turn increase its concentration in plant parts. Similar results were recorded by **Dierent and Faby(2003), Ibrahim *et al.*,(2004) and Yildirm *et al.*,(2009)** all working on strawberry.

c. Effect of the interaction:

Regarding the effect of the interaction, the same data in Table (11) indicate that spray plants of cv. Festival with different studied mineral salts especially with potassium nitrate at 1.5% recorded the highest N, P, K and carbohydrates during the two seasons of study compared with other tested interaction treatments.

4.2.3. Fruit yield and its components:

Data recorded in Tables (12 and 13) show the effect of cultivars, spraying with mineral salts as well as their interaction on total fruit yield and its components during both seasons of study.

a. Effect of cultivars:

Concerning the effect of cultivars on total fruit yield and its components expressed as early yield, exportable and

Table (12): Effect of cultivars and spray with calcium and potassium salts as well as their interaction on total fruits yield and its components of strawberry plants during 2007/2008 season.

Treatments		2007/2008					
CV	Spray	Early yield(t/fed	Exportable yield (ton/fed)	Marketable yield (ton/fed)	Total yield(g/plant)	Total yield(t/fed)	Unmarketable yield(kg/fed)
Sweet Charlie		3.73	1.085	19.325	447.62		817.36
Festival		3.14	1.407	19.473	449.43	20.220	747.18
L.S.D .at0.05%		0.14	0.236	N.S	N.S	N.S	58.18
	Control	3.03	1.090	17.204	403.80	18.170	966.10
	Calcium Colorid (0.5%)	3.25	1.182	18.776	433.05	19.485	708.75
	Calcium nitrat (1%)	3.36	1.324	20.111	462.21	20.799	687.75
	potassium nitrat (1.5%)	3.60	1.293	20.684	476.61	21.450	766.50
	Mono potassium phosphate(1%)	3.94	1.343	20.232	466.97	21.014	782.25
L.S.D .at0.05%		0.25	0.128	0.537	11.92	0.535	67.76
Sweet Charlie	Control	3.30	0.894	17.228	405.65	18.253	1025.00
	Calcium Colorid (0.5%)	3.56	1.007	18.575	428.82	19.295	720.30
	Calcium nitrat (1%)	3.67	1.181	19.918	459.05	20.655	737.10
	potassium nitrat (1.5%)	3.93	1.140	20.276	468.13	21.068	791.70
	Mono potassium phosphate(1%)	4.18	1.205	20.627	476.48	21.440	812.70
Festival	Control	2.77	1.286	17.181	401.95	18.088	907.20
	Calcium Colorid (0.5%)	2.93	1.356	18.978	437.28	19.675	697.20
	Calcium nitrat (1%)	3.04	1.467	20.304	465.37	20.942	638.40
	potassium nitrat (1.5%)	3.27	1.445	21.092	485.10	21.833	741.30
	Mono potassium phosphate(1%)	3.70	1.481	19.836	457.48	20.588	751.80
L.S.D .at0.05%		0.36	0.181	0.760	16.86	0.757	95.83

Table (13): Effect of cultivars and spray with calcium and potassium salts as well as their interaction on total fruits yield and its components of strawberry plants during 2008/2009 season.

Treatments		2008/2009					
CV	Spray	Early yield(t/fed)	Exportable yield(ton/fed)	Marketable yield (ton/fed)	Total yield(g/plant)	Total yield(t/fed)	Unmarketable yield(kg/fed)
Sweet Charlie		7.45	2.833	19.918	452.69	20.371	452.62
Festival		5.75	2.953	20.779	471.64	21.223	443.66
L.S.D .at0.05%		0.65	0.082	0.630	13.85	0.623	N.S
	Control	6.21	2.600	19.011	434.44	19.549	537.60
	Calcium Colorid (0.5%)	6.48	2.857	19.906	451.17	20.301	394.80
	Calcium nitrat (1%)	6.60	2.945	20.550	465.18	20.933	383.25
	potassium nitrat (1.5%)	6.79	2.995	21.417	486.04	21.871	453.60
	Mono potassium phosphate(1%)	6.91	3.069	20.86	474.01	21.331	471.45
L.S.D .at0.05%		0.57	0.110	0.660	15.64	0.703	44.31
Sweet Charlie	Control	7.15	2.633	18.971	433.05	19.488	516.60
	Calcium Colorid (0.5%)	7.48	2.827	19.515	442.38	19.907	392.00
	Calcium nitrat (1%)	7.51	2.905	19.689	446.75	20.103	413.70
	potassium nitrat (1.5%)	7.52	2.860	19.943	453.42	20.405	462.00
	Mono potassium phosphate(1%)	7.59	2.942	21.474	487.85	21.953	478.80
Festival	Control	5.26	2.567	19.051	435.83	19.610	558.60
	Calcium Colorid (0.5%)	5.49	2.887	20.297	459.97	20.695	397.60
	Calcium nitrat (1%)	5.69	2.986	21.410	483.60	21.763	352.80
	potassium nitrat (1.5%)	6.07	3.129	21.813	494.60	22.258	445.20
	Mono potassium phosphate(1%)	6.24	3.196	21.326	484.23	21.790	464.10
L.S.D .at0.05%		0.81	0.156	1.000	22.12	0.994	62.67

marketable yield as well as total yield either per plant or feddan and unmarketable yield. Data recorded in Tables (12 and 13) show that all measured yield parameter were significantly differed among the tested cultivars. In this regard, such differences did not reach the level of significance in case of marketable and total produce yield for both plant and feddan during the first season only. In addition, cv. Festival recorded the highest produced total yield and its components except the early yield which was highest in case of cv. Sweet Charlie. Moreover, the lowest infected yield (unmarketable) was recorded in case of cv. Festival. Obtained results are true during both seasons of study. Such difference in total produced yield and its components between the tested cultivars are connected with the differences in vegetative growth performance which in turn affect on the productability of plants in each cultivar. In this regard, **Libek (2002), Mezzetti *et al.*, (2002), Rugianins *et al.*, (2002), Turemis (2002), David and Dill (2003), Faedi *et al.*, (2008), Nir-Dai *et al.*, (2008), Simpson *et al.*, (2008) and Ahmed (2009)** all working on strawberry reported significant differences in the production of different tested strawberry cultivars. However, **Mohamed (2003), Aranda *et al.*, (2005) and Molinar and Yang (2006)** found that no significant differences among strawberry cultivars in the early and total produced yield.

b. Effect of mineral salts:

With regard to the effect of spray treatments (calcium and potassium compounds) on total fruit yield and its components i.e., early, exportable, marketable as well as total yield per plant

or feddan and unmarketable yield, data in Tables (12 and 13) reveal that spraying strawberry plants six times at ten days intervals with the tested mineral salts at different studied concentration significantly increased the total produced yield and its components except the infected yield which was decreased compared to the control treatment .

In this regard, the highest values of early and exportable yield were recorded in case of using mono potassium phosphate while, the highest marketable and total yield for both plant and feddan were recorded in case of using potassium nitrate during the first season only. On the other hand, spray the plants with both potassium mono phosphate at 1% and potassium nitrate at 1.5% exhibited the highest produced yield and its component without significant differences among them compared with other studied spray treatments during the second season of study. However, using Ca salts decreased the infected fruits compared with other tested treatments.

The higher yield in case of using potassium salts may be attributed to the role of potassium in translocation of produced photosynthetic assimilates and accumulation of it in storage organs (fruits) and in turn increase the number, weight and size of it fruits which consequently affect positively on yield. Also such increases are connected with the increase in vegetative growth which connected greatly with the productvty of plant. In this regard, similar results were reported by **Maroto *et al* (1998), Choir *et al.*, (2000), Kaya *et al.*, (2003), El-Shami *et al.*, (2004), Lanauskas *et al.*, (2006) and Singh *et al.*, (2009)** found

that preharvest application of calcium and potassium results positively affected fruit yield and its components.

c. Effect of the interaction:

As for the effect of the interaction, the same data in Tables (12 and 13) show that, spraying the plants of cv. Sweet Charlie by mono potassium phosphate at 1% and plants of cv. Festival with both potassium salts reflected the highest produced yield and its components compared with other interaction treatments during both seasons of study.

4.2.4. Fruit physical quality:

Data presented in Table (14) show the effect of different studied cultivars, mineral salts and their interaction on physical fruit characteristics during both seasons of study.

a. Effect of cultivars:

From data recorded in Table (14) it was obvious that fruit physical quality expressed as average fruit weight, length, and fruit firmness were significantly differed among the studied cultivars during both growth seasons. In addition, fruit diameter was not affected as a result of used genotypes. In this regard, fruits produced by cv. Festival show the highest fruit weight, length and firmness compared with that of fruits produced by cv. Sweet Charlie but there is no difference in fruit diameter during both seasons of study. This increments in morphological characters of fruit in case of cv. Festival may be due to vigorous in vegetative growth Table (11 and 12) which in turn affect on size of produced fruits.

Table (14): Effect of cultivars and spray with calcium and potassium salts as well as their interaction on physical fruit quality of strawberry plants during two seasons of study.

treatments		2007/2008				2008/2009			
CV	Spray	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit firmness (g/cm2)	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit firmness (g/cm2)
Sweet Charlie		20.33	4.32	3.23	68.26	15.91	3.98	3.08	88.09
Festival		24.03	4.69	3.35	151.84	20.24	4.52	3.21	156.30
L.S.D .at 0.05%		1.49	0.26	N.S	13.19	1.98	0.27	N.S	7.40
	Control	22.17	4.53	3.18	102.55	16.41	4.06	3.01	102.89
	Calcium Colorid (0.5%)	21.44	4.38	3.31	116.40	17.71	4.28	3.13	136.24
	Calcium nitrat (1%)	21.64	4.41	3.28	110.88	19.25	4.32	3.23	124.77
	potassium nitrat (1.5%)	22.61	4.53	3.35	108.74	18.25	4.32	3.16	118.90
	Mono potassium phosphate(1%)	23.03	4.67	3.32	111.70	18.74	4.26	3.17	128.18
L.S.D .at 0.05%		1.80	N.S	0.13	9.22	1.60	0.15	0.18	10.28
Sweet Charlie	Control	20.02	4.35	3.15	61.01	14.58	3.87	2.92	73.25
	Calcium Colorid (0.5%)	19.45	4.20	3.22	72.93	16.48	4.02	3.22	105.05
	Calcium nitrat (1%)	20.42	4.40	3.25	69.00	16.28	4.00	3.07	89.44
	potassium nitrat (1.5%)	19.76	4.17	3.27	68.10	16.21	4.07	3.12	78.41
	Mono potassium phosphate(1%)	21.99	4.50	3.25	70.28	16.00	3.92	3.05	94.31
Festival	Control	24.32	4.72	3.22	144.10	18.25	4.25	3.10	132.52
	Calcium Colorid (0.5%)	23.44	4.57	3.40	159.88	18.95	4.55	3.05	167.42
	Calcium nitrat (1%)	22.86	4.42	3.32	152.75	22.21	4.62	3.38	160.10
	potassium nitrat (1.5%)	24.06	4.85	3.42	149.38	20.30	4.57	3.200	159.40
	Mono potassium phosphate(1%)	25.46	4.90	3.40	153.13	21.47	4.60	3.30	162.05
L.S.D .at 0.05%		2.55	0.41	0.18	13.05	2.26	0.22	0.25	14.53

In this connection, **Aranda *et al.*, (2004), Faedi and Baruzzi (2004), Finn (2004), Jensen and Andersen (2004), Aranda *et al.*, (2005), Khanizadeh *et al.*, (2005) and Ahmed (2009)** reported that there were some differences were found among the all cultivars in fruit physical parameter (fruit, length, diameter and shape).

b. Effect of mineral salts.

Concerning the effect of mineral salts i.e. $CaCl_2$, Ca $(NO_3)_2$, K NO_3 and $KHPO_4$ at different tested concentrations the same data in Table (14) indicate that spraying strawberry plants with all aforementioned mineral salts significantly increased all measured fruit physical parameters compared with the control treatments during the two seasons of the experiment.

In this concern, spray plants with potassium salts (mono potassium phosphate and potassium nitrate) during the first season and calcium nitrate during the second one reflected the highest values in average fruit length, diameter and weight. However, the highest fruit firmness was recorded incase of spray plants with calcium chloride at 0.5% during both seasons of study. On the other hand, the lowest values in fruit length, diameter and weight were recorded in case of using calcium chloride. Such increments in fruit length, diameter and weight in case of KNO_3, $KHPO_4$ and Ca $(NO_3)_2$ may be due to the effect of such mineral constituents on water content of fruit which affect on cell formation and cells size in fruit receptacle and in turn on fruit parameters. **Grajkowski *et al.* (2007) and Singh *et al.*, (2009)** pointed out that preharvest spray of plants with mineral compounds containing calcium and potassium elements

produced largest and most firm fruits. However, **Ram Asrey *et al.*, (2004) and Lanauskas *et al.*, (2006)** reported that such salts had no effect on physical fruit quality.

c. Effect of the interaction:

As for the effect of the interaction between tested cultivars and mineral salts, the same data in Table (14) reveal that the highest values in average fruit parameters (length, diameter and weight) were recorded as a result of spraying the plant of cv. Festival by potassium nitrate at 1.5% followed by those sprayed with potassium mono phosphate of the same cultivars during the first season, In addition spray the plants with Ca $(NO_3)_2$ exhibited the highest values in average fruit weight , length and diameter during the second season Moreover, calcium chloride treatment via cv. Festival exhibited the highest values of fruit firmness during both seasons of study. Such increase in fruit firmness in case of using $CaCl_2$ may be due to Ca element is the main constituent of cell wall and in turn increased its solidity. In this regard, **Cheour *et al.*, (1990), Pawel and Mariusz (2003) and Lanauskas *et al.*, (2006)** reported similar results.

4.2.5. Fruit chemical quality:

Data recorded in Tables (15 and 16) show the effect of cultivars, spray with Ca and K compounds as well as their interaction on chemical fruit quality of strawberry during both seasons of study.

a. Effect of cultivars:

Data in Tables (15 and16) show that chemical fruit quality expressed as totals soluble solids, total acidity, vitamin C, reducing and total sugars as well as anthocyanin concentrations

Table (15): Effect of cultivars and spray with calcium and potassium salts as well as their interaction on chemical constituents in fruits of strawberry plants during 2007-2008 season.

treatments		2007/2008					
CV	Spray	T. S.S%	Vit.C (mg/100g f.w)	Total titratable acidity (mg/100g f.w)	Total sugars%	Reducing sugars%	Anthocyanin (mg/100g f.w)
Sweet Charlie		10.95	44.26	0.59	7.72	4.67	63.57
Festival		10.24	41.80	0.67	6.69	3.64	87.04
L.S.D .at0.05%		0.69	1.03	0.02	0.06	0.09	1.00
	Control	10.36	41.66	0.66	7.15	4.12	73.02
	Calcium Colorid (0.5%)	10.14	40.83	0.68	7.14	4.10	71.56
	Calcium nitrat (1%)	10.78	43.16	0.63	7.19	4.16	76.15
	potassium nitrat (1.5%)	10.78	44.33	0.62	7.24	4.19	74.86
	Mono potassium phosphate(1%)	10.91	45.16	0.59	7.30	4.22	80.93
L.S.D .at0.05%		0.57	2.24	0.05	0.14	0.09	1.73
Sweet Charlie	Control	10.84	42.00	0.62	7.67	4.63	62.36
	Calcium Colorid (0.5%)	10.65	41.33	0.64	7.66	4.61	61.53
	Calcium nitrat (1%)	10.99	44.66	0.59	7.73	4.67	63.17
	potassium nitrat (1.5%)	11.03	46.33	0.57	7.75	4.71	64.08
	Mono potassium phosphate(1%)	11.23	47.00	0.53	7.81	4.75	66.71
Festival	Control	9.88	41.33	0.70	6.64	3.60	83.68
	Calcium Colorid (0.5%)	9.64	40.33	0.73	6.62	3.59	81.58
	Calcium nitrat (1%)	10.57	41.66	0.66	6.66	3.65	89.14
	potassium nitrat (1.5%)	10.54	42.33	0.66	6.73	3.67	85.65
	Mono potassium phosphate(1%)	10.60	43.33	0.64	6.79	3.70	95.16
L.S.D .at0.05%		0.81	3.17	0.07	0.21	0.13	2.44

Table (16): Effect of cultivars and spray with calcium and potassium salts as well as their interaction on chemical constituents in fruits of strawberry plants during 2008-2009 season.

Treatments		2008/2009					
CV	Spray	T.S.S%	Vit. C (mg/100g f.w)	Total titratable acidity (mg/100g f.w)	Total sugars%	Reducing sugars %	Anthocyanin (mg/100g f.w)
Sweet Charlie		10.06	54.60	0.64	7.65	4.61	76.09
Festival		9.55	54.00	0.71	6.62	3.57	110.29
L.S.D .at 0.05%		0.27	0.49	0.04	0.17	0.15	4.66
	Control	9.52	52.66	0.70	7.09	4.04	91.64
	Calcium Colorid (0.5%)	9.38	52.00	0.70	7.07	4.02	87.93
	Calcium nitrat (1%)	10.11	55.00	0.68	7.13	4.07	93.82
	potassium nitrat (1.5%)	10.00	55.66	0.67	7.18	4.12	94.76
	Mono potassium phosphate(1%)	10.00	56.16	0.62	7.22	4.19	97.79
L.S.D .at 0.05%		0.52	1.36	0.05	0.10	0.08	3.18
Sweet Charlie	Control	9.68	53.00	0.66	7.60	4.57	73.20
	Calcium Colorid (0.5%)	9.63	52.00	0.66	7.58	4.55	65.42
	Calcium nitrat (1%)	10.25	55.00	0.64	7.65	4.59	76.56
	potassium nitrat (1.5%)	10.35	56.33	0.64	7.69	4.65	81.70
	Mono potassium phosphate(1%)	10.38	56.66	0.61	7.73	4.70	83.58
Festival	Control	9.37	52.33	0.75	6.58	3.52	110.09
	Calcium Colorid (0.5%)	9.13	52.00	0.74	6.56	3.49	110.45
	Calcium nitrat (1%)	9.97	55.00	0.73	6.61	3.55	111.08
	Potassium nitrat (1.5%)	9.66	55.00	0.70	6.66	3.58	107.82
	Mono potassium phosphate(1%)	9.62	55.66	0.64	6.69	3.70	112.00
L.S.D .at 0.05%		0.74	1.92	0.07	0.14	0.11	4.50

were significantly differed among the tested cultivars during both seasons of growth. In this respect, cv. Sweet Charlie exhibited the highest concentration of total soluble solids, vitamin-C, total and reducing sugars, while fruits of cv. Festival reflected the highest values for total titratable acidity and anthocyanin content. Such results are true during both seasons of growth. The superiority of cv. Sweet Charlie in total and reducing sugars and vitamin-C content may be due to the highest total soluble solids which in turn affected by photo assimilation rate.

In this connection, **Hassan *et al.*, (2001), Hakala *et al.*, (2002), Yommi *et al.*, (2003), Faedi and Baruzzi (2004), Aranda *et al.*, (2005) Insfran *et al.*, (2006) and Ahmed (2009)** reported that significant differences were detected among the studied cultivars and strains of strawberry in total soluble solids, titratable acidity, ascorbic acids total and reducing sugars content of fruits.

b. Effect of mineral salts.

Data recorded in Tables (15 and 16) show that spraying the plants with mineral salts, i.e., $CaCl_2$, $Ca(NO_3)_2$, KNO_3 and $KHPO_4$ at the different tested concentrations statistically affected fruit contents of total soluble solids, total acidity, vitamin-C, reducing and total sugars as well as anthocyanin compared to the control treatment. In addition, such enhancing effect on all aforementioned chemical constituent was obvious in case of using potassium nitrate and potassium mono phosphate except in case of total acidity which was reduced as a result of using potassium slats. Moreover, using $CaCl_2$ salt resulted in higher

acidity content and reduced all other chemical constituents compared with the control and other studied treatments during both season of study.

c. Effect of the interaction

As for the effect of the interaction between studied cultivars and mineral salts, the same data in Tables (15 and 16) indicate that spraying the plants six times starting at the beginning of flowering and every 15 days intervals with mono potassium phosphate reflected the highest fruit content of T.S.S., vitamin-C., total and reducing sugars especially in case of cv. Sweet Charlie. However, such treatment reflected the highest anthocyanine especially in case of cv. Festival. On the other hand, using $CaCl_2$ increased total titratable acidity in both cultivars and the highest value was noticed in case of cv. Festival.