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ABSTRACT

Two expeniments were undertaken on the Exper. Field on tomato cv. U.C. 97-3 at Fac. Agric. Moshtohor. Zagazig Univ. in winter season of 1987/1988 and 1988/1989 to study the effect of three different levels of P and K fertilizers in combination with seven seed-cold treatments on plant growth and chemical composition of plant foliage. Obtained results revealed that keeping tomato seeds at -3°C for 24 hours showed the highest vegetative growth as well as N, P and K content of tomato plant foliage when combined with the second used level of fertilizers (99 kg N + 48 kg P_2O_5 + 48 kg. K_2O/fad.).

However, reducing, non-reducing and total sugars content in plant foliage were at their highest values in plants fertilized with the same level of fertilizers and the seed-cold treatment of -1°C for 24 or 12 hours.

INTRODUCTION

Tomato (lycopersicon esculentum, Mill) is considered as one of the most important vegetable crops from which 166826 Fad. are grown in Egypt in the winter season of 1988. Many factors affected tomato plant growth and chemical composition of plant foliage, especially when tomato is grown under short season conditions in winter.

Among the pathways followed for improving tomato plant growth and increasing the chemical constituents of tomato plant foliage to be in a hardened state, were the seed cold treatment within PK soil application. It has been reported by many investigators working on different vegetable crops that exposing plant organs to low temperature helps plants afterwards to endure frost injury (Belousova, 1972 & 1973; Abdalla et al., 1983 on some solanacious crops and Zaki et al., 1982; Shafshak 1987 and Eid et al., 1988 on some legume crops.

The favourable effect of PK application on the vegetative growth of tomato plant has been indicated by Gupita & Shukla (1977); El-Sawah, (1981); El-Beheidi et al., (1988) and El-Sawy (1988) on tomato and Farag (1984) on sweet pepper.

The promising effect of the interaction between seed-cold treatment and the fertilization level on the plants vegetative growth has been reported by Zurawicz and Stushnoff (1977) on strawberry and Eid et al., (1988) on broad bean.

The seed-cold treatment had a favourable influence on the chemical constituents of plant foliage (Abdalla et al., 1983 on sweet pepper and Eid et al., 1988 on broad bean) as regard to N, P and K; Ledov'skii and Bondarenko (1974) working on tomato and pollock and Iloyd (1987), on pea as regard to reducing, non-reducing and total sugars.

Phosphatic and potassic fertilizers levels had a pronounced effect on N, P and K contents in plant foliage (El-Sawah, 1981 and El-Beheidi et al., 1988 both working on tomato and Farag, 1984 on sweet pepper) as well as reducing, non reducing and total sugars (Farag, 1984 on sweet pepper).

The combined effect of seed cold treatment within PK fertilization had the most pronounced influence on the mineral content of N, P and K in plant foliage (Zurawicz & Stushnoff, 1977 on Strawberry and Eid et al., 1988 on broad bean) as well as reducing non reducing and total sugars (Ledovskii and Bondarenko, 1974 working on tomato and pollock and Lloyd 1987 on pea).

The aim of this investigation is to elucidate the effect of seed cold treatment and PK soil application on the vegetative growth and chemical composition of plant foliage.

MATERIALS AND METHODS

Two experiments were carried out at the Experimental Farm of the Fac. of Agric., Moshtohor, Zagazig Univ. during 1987/1988 and 1988/1989 winter seasons. Seeds of tomato (Lycopersicon esculentum, Mill.) cv. U.C. 97-3 were soaked in distilled water for 48 hours before the exposure to the used cold treatments. Seeds were then sown in the nursery on November 1st 1987 and October 25th 1988.

Transplanting took place on December 5th and 9th 1987 and 1988 respectively. Transplants were planted at 30 cm apart on one side of ridges 100 cm wide.

The experiment included 21 treatments resulted from combination of three different levels of phosphorus and potassium fertilizers (32 kg P_2O_5 + 36 kg K_2O/fad., 48 kg P_2O_5 + 48 kg K_2O/fad. and 64 kg P_2O_5 + 72 kg K_2O/fad.) and seven seed-cold treatments (-1, -2 or -3°C for 12 or 24 hours beside the control one). The nitrogen fertilizers was added as a fixed quantity at the rate of 99 kg N/fad. for each of the previously mentioned levels of P and K fertilizers.

Fertilizers were applied in the form of Ammonium nitrate (33.5% N), Calcium superphosphate (16.5% P_2O_5) and potassium sulphate (48% K_2O). Fertilizers were divided into three equal portions and then added at 3, 7 and 11 weeks after transplanting.

A split plot design with four replicates was adopted. The plot area was about 1/380 faddan. Other cultural practices were carried out as commonly followed in the district.

The temperature degrees (°C) and relative humidity (%) prevailing at Kalubia governorate at the growing seasons of this work are presented at the following table.

EXPERIMENTAL PROCEDURES

1- Vegetative Growth Characteristics:

At full blooming stage, four plants were randomly taken from each plot (about 80 days after transplanting) for meausring plant height, stem diameter, number of shoots and leaves per plant as well as recording fresh and dry weight per plant.

Chemical Composiiton of Plant Foliage:

In the digested dry matter of plant foliage, each of total nitrogen, phosphorus and potassium were determined and then their uptake as mg/plant was calculated. Reducing, non-reducing and total sugars percentage were also determined. Chemical analysis were carried out according to the methods of Pregl (1945) for N, Murphy and Riely (1962) as modified by John (1970) for P, Brown and Lilleland (1946) for K and Michel et al. (1956) for sugars.

The month	Temperature °C			Relative humidity %
	Maximum	Minimum	Average	
	Season 1987/1988			
October	28.1	15.7	21.9	61
November	23.1	8.0	15.6	65
December	19.7	8.6	14.2	68
January	18.0	6.9	12.4	62
February	19.7	7.1	13.4	59
March	22.1	8.4	15.3	57
April	28.2	14.6	21.4	55
May	35.9	17.6	26.8	38
	Season 1988/1989			
October	27.8	14.3	21.0	64
November	22.1	7.7	14.9	64
December	19.2	8.2	13.7	67
January	16.2	5.2	10.7	74
February	19.6	7.5	13.5	62
March	22.3	7.9	15.1	64
April	29.7	11.7	20.7	54
May	31.7	14.5	23.1	48

All collected data were subjected to the statistical analysis as mentioned by Snedecor and Cochran (1968).

RESULTS AND DISCUSSION

1- Vegetative Growth:

Data presented in Table (1) show that, all used seed-cold treatments significantly increased different studied tomato plant vegetative growth characters expressed as plant height, stem diameter, number of shoots and leaves as well as fresh and dry weight per plant compared with control treatment.

Such data clearly show that, seed-cold treatment at either -1, -2 or -3°C for 24 hours showed the highest values of different studied growth charcters at both successive seasons of this work. Obtained results may be due to that such treatments promoted N, P and K uptake as shown in Table (4).

Many investigators reported such favourable effect of exposing plant organs to low temperature. They attributed this effect to that, exposure to low temperature may be useful for hardening the plant against frost. This may be due to the increase in total sugars and soluble protein in the cellular level (Ledov'skii and Bondarenko, 1974). Moreover, Chen, and Li (1974), suggested that during cold acclimatization, higher abscisic acid (ABA) levels induce synthesis of specific proteins which are responsible for the increase of frost hardiness. Moreover, Levitt (1980), found that exposure of plant leaves of tomato to low temperature may help plants afterwards to endure frost injury through the effect on the degree of stomatal aperture.

The reported results of this work are also in agreement with those obtained by Belousova (1972), on egg plant; Belousova (1973) on pepper; Abdalla *et al.* (1983) on sweet pepper; Zaki *et al.*, (1982) on broad bean; Shafshak (1987) on pea and Eid *et al.*, (1988) on broad bean. Referring to the effect of different levels of phosphorus and potassium fertilizers on tomato plants vegetative growth, it is obvious from data in Table (2) that medium used level (99 kg N + 48 kg P_2O_5 + 48 kg K_2O/fad.) of fertilizers enhanced plant growht expressed as plant height, stem diameter, number of shoots and leaves per plant as well as both of fresh and dry weight per plant as compared with either used low or high levels at both successive seasons of this work. However, no significant difference could be detected

Table (1): Effect of seed-cold treatment on vegetative growth of tomato plants.

Seed-cold treatment		Plant height (cm)	Stem diameter (cm)	No. of shoots/ plant	No. of leaves/ plant	Fresh weight/ plant (g)	Dry weight/ plant (g)
Temperature °C	Time hrs.						
		Season 1987/1988					
Control		38.92	0.98	10.42	62.33	381.75	52.13
-1	12	44.00	1.10	12.08	72.17	408.08	56.75
	24	45.92	1.36	14.33	82.58	444.00	61.57
-2	12	45.25	1.05	12.25	66.67	395.17	56.64
	24	43.92	1.25	13.33	69.50	456.67	63.90
-3	12	43.25	1.08	12.25	68.67	421.17	60.17
	24	46.58	1.30	13.50	87.83	456.00	65.57
L.S.D. at 5%		0.76	0.08	0.70	1.57	6.52	3.39
		Season 1988/1989					
Control		39.25	0.91	9.67	47.50	370.00	50.71
-1	12	43.58	1.04	11.33	56.75	394.17	55.01
	24	45.58	1.33	13.58	69.17	428.75	59.28
-2	12	44.58	1.03	11.75	51.00	382.92	54.49
	24	43.83	1.23	12.75	53.58	440.83	61.96
-3	12	43.17	1.03	11.58	52.67	407.08	58.09
	24	46.75	1.26	12.83	70.91	441.67	63.60
L.S.D. at 5%		1.10	0.06	0.77	1.11	7.72	n.s

Table (2'): Effect of rate of phosphorus and potassium fertilizers on vegetative growth of tomato plant.

Levels of fertilizer (kg/Fad.) N	P_2O_5	K_2O	Plant height (cm)	Stem diameter (cm)	No. of shoots/ plant	No. of leaves/ plant	Fresh weight/ plant (g)	Dry weight /plant (g)
					Season 1987/1988			
99	32	36	43.11	1.14	12.71	67.96	368.18	42.71
99	48	48	45.11	1.21	12.86	77.18	479.39	66.58
99	64	72	43.68	1.12	12.21	73.32	422.21	58.47
L.S.D. at 5%			0.58	0.04	0.39	1.00	4.64	2.43
					Season 1988/1989			
99	32	36	42.71	1.08	11.85	53.89	356.96	52.34
99	48	48	45.18	1.17	12.18	61.00	461.78	63.73
99	64	72	43.57	1.08	11.75	57.21	409.28	56.69
L.S.D. at 5%			0.40	0.04	n.s	0.60	6.15	2.65

Table (3): Effect of interaction between seed-cold treatment and fertilization on vegetative growth of tomato plants.

Levels of fertilizer (kg/Fad.)			Seed-cold treatment		Season 1987/1988						Season 1988/1989					
N	P_2O_5	K_2O	Temperature °C	Time hrs	Plant height (cm)	Stem diameter (cm)	No. of shoots/ plant	No. of leaves/ plant	Fresh weight/ plant g.	Dry weight/ plant g.	Plant height (cm)	Stem diameter (cm)	No. of shoots/ plant	No. of leaves/ plant	Fresh weight/ plant g.	Dry weight/ plant g.
99	32	36	Control		37.2	0.9	10.5	59.2	322.0	48.1	37.5	0.8	9.5	45.5	312.5	47.1
			-1	12	43.2	1.0	12.7	66.0	352.5	48.6	42.7	0.9	12.0	51.2	341.2	47.4
				24	45.7	1.4	16.2	79.2	384.7	54.0	46.6	1.3	14.2	70.0	370.0	52.3
			-2	12	45.0	1.0	12.2	60.7	340.2	53.5	43.5	1.0	11.7	47.7	328.7	52.2
				24	42.7	1.2	13.5	64.5	403.7	56.3	42.2	1.2	12.7	48.7	392.5	55.6
			-3	12	42.2	1.0	12.0	67.2	349.2	52.4	42.0	0.9	11.2	52.0	342.5	51.6
				24	45.5	1.2	12.7	78.7	424.7	61.7	45.5	1.2	11.5	62.0	411.2	59.9
99	48	48	Control		41.0	1.0	10.7	65.7	446.2	59.4	41.2	0.9	10.0	50.0	432.5	57.6
			-1	12	45.0	1.1	11.7	77.2	464.2	67.3	44.7	1.1	10.7	62.5	445.0	59.9
				24	46.5	1.4	14.0	87.2	504.2	69.6	46.2	1.3	13.0	70.5	487.5	66.5
			-2	12	45.7	1.0	12.5	69.5	447.5	63.7	45.7	1.0	12.0	52.5	433.7	60.0
				24	45.5	1.3	13.5	73.0	513.0	70.2	45.5	1.3	12.7	58.0	493.7	67.6
			-3	12	44.2	1.1	12.5	69.7	486.7	70.8	44.5	1.1	12.0	53.5	465.0	66.8
				24	48.0	1.3	15.0	97.7	491.7	69.7	48.2	1.3	14.7	80.0	475.0	67.4
99	64	72	Control		38.5	0.9	10.0	62.0	377.0	48.8	39.0	0.9	9.5	47.0	365.0	47.2
			-1	12	45.5	1.0	11.7	73.2	407.5	59.2	43.2	1.0	11.2	56.5	396.2	57.6
				24	45.0	1.2	13.7	81.2	443.0	60.9	45.0	1.2	13.5	67.0	428.7	51.1
			-2	12	43.5	1.0	12.0	69.7	397.7	52.5	44.5	1.0	11.5	52.7	386.2	51.1
				24	43.2	1.2	13.0	71.0	453.2	65.1	43.7	1.1	12.7	54.0	436.2	62.6
			-3	12	45.2	1.1	12.2	69.0	425.5	57.2	43.0	1.0	11.5	52.7	413.7	55.7
				24	38.5	1.2	12.7	87.0	451.5	65.8	46.5	1.2	12.2	70.7	438.7	63.4
L.S.D. at 5%					n.s	n.s	n.s	2.7	11.3	n.s	n.s	n.s	1.3	1.9	13.3	3.4

Table (4): Effect of seed-cold treatment on chemical composition of tomato plant foliage.

Seed-cold treatment		Total nitrogen	Phosphorus	Potassium	Reducing sugar	Non-reducing sugar	Total sugars
Temperature °C	Time hrs	mg/plant			mg/100 g dry weight		
Season 1987/1988							
Control		2103	404	1738	7.76	2.00	9.76
-1	12	1981	482	2080	10.81	4.45	15.26
	24	2179	419	2308	11.25	4.74	15.99
-2	12	1911	436	2012	10.31	4.19	14.50
	24	2271	523	2406	9.07	3.73	12.80
-3	12	2366	561	2405	7.06	2.93	9.99
	24	2446	608	2077	7.92	3.26	11.18
L.S.D. at 5%		80.37	19.59	102.10	0.08	0.06	0.15
Season 1988/1989							
Control		2023	364	1673	7.04	1.98	9.02
-1	12	1921	466	2014	9.87	4.20	14.07
	24	2074	401	2207	10.34	4.65	14.99
-2	12	1828	420	1923	9.52	4.10	13.62
	24	2174	511	2323	8.26	3.59	11.85
-3	12	2180	523	2294	6.44	2.82	9.26
	24	2349	574	1971	7.24	2.95	10.19
L.S.D. at 5%		107.37	21.52	125.22	0.07	0.07	0.12

with number of shoots during the second season of growth.

Such results may be explained on the bases that the soil of the Experimental farm has enough content of N, P and K minerals as shown previously of this work that high used level of fertilizers was uneffective.

Many investigators found similar trend where medium used level of macronutrients resulted in the highest plant growth, among them, Gupta and Shukla (1977); El-Sawah (1981); El-Beheidi et al., (1988) and El-Sawy (1988) on tomato and Farag (1984) on sweet pepper.

With regard to the effect of interaction between both of the two main factors, it is evident from data in Table (3) that second used level of fertilizers (99 kg N + 48 kg P_2O_5 + 48 kg K_2O/fad.) combined with seed-cold treatment at -1, -2 or -3°C for 24 hrs. resulted in the highest values of different studied vegetative growth characteristics. However, differences between such values did not reach the level of significancy in some characters i.e. plant height and stem diameter whileas variances were statistically significant for number of leaves, fresh wieght per plant at both growing seasons of this work.

Obtained results are in confirmity with those reported by Zurawicz and Stushnoff (1977) on strawberry who mentioned that K spray and complete fertilizers soil application at enough rates resulted in giving plants more resistance to cold injury and promoted plant growth.

Moreover, Eid et al. (1988), working on broad bean showed that exposing seeds to low degree of temperature (5°C for 7 days) with phosphorus soil application at 16 or 32 kg P_2O_5/fad. had the most pronouncing effect on plant growth characteristics.

Generally, it may be concluded that exposing tomato seeds after soaking in distilled water for 48 hours to low temperature (-1 to -3°C) for 24 hours and using a complete fertilizer containing 99, 48 and 48 kg/fad. of each of N, P_2O_5 and K_2O respectively resulted in plants of the highest values of different studied growth characteristics.

2- Chemical Composition of Plant Foliage:

Data in Table (4) show clearly that most of the used seed-cold treatments significantly increased total nitrogen, phosphorus and potassium contents of plant foliage than

that of the control one at both gowing seasons of 1987/1988 and 1988/1989.

Treatments which showed the highest values of N and P content in tomato plants were -3°C for 24 hours followed by that at -3°C for 122 hrs or -2°C for 24 hrs. However, treatment of -2°C for 24 hours and that of -3°C for 12 hours showed the highest K content in plant foliage.

Obtained results are in confirmity with those mentioned by Abdalla et al. (1983) on sweet pepper and Eid et al., (1988) on broad bean.

These results may be explained on the base that treatments showed the highest plant vegetative growth expressed as fresh and dry weight per plant (-2 or -3°C for 24 hours) were the same that resulted in the highest values of N, P and K content. This may be attributed to that such plant chemical constituents are calculated as plant uptake (mg/plant). That is why N, P and K content are positively related with plant growth.

With regard to the effect of seed-cold treatment on reducing, non reducing and total sugars content of plant foliage, it is evident from data presented in Table (4) that most of the used seed-cold treatments had an enhancing effect in comparison with control treatment in this respect. Treatments which showed the highest values in this respect were those of -1°C for 24 hours followed by that for 12 hours.

Similar results were obtained by Pollock and Lloyd (1987), who reported that exposing pea plants to low temperature (5°C for 6 hours) produced higher content of carbohydrates in leaves. Ledov'skii and Bondarenko (1974), indicated that plant exposure to low temperature may be useful for hardening the plant against frost. They attributed this to the increase in total sugars and soluble protein in the cellular level.

WIth regard to the effect of rate of phosphatic and potassic fertilizers on chemical constituents of tomato plants foliage, data concerned with total nitrogen, phosphorus and potassium as well as reducing, non-reducing and total sugars of plant foliage are presented in Table (5). Such data show clearly that increasing fertilizers level significantly increased the values of different studied constituents of plant foliage up to the highest used one (99 kg N + 64 kg P_2O_5 + 72 kg K_2O/fad.) which had the most

Table (5): Effect of rate of phosphorus and potassium fertilizers on chemical composition of tomato plant foliage.

Levels of fertilizer (kg/Fad.) N	P_2O_5	K_2O	Total nitrogen (mg/plant)	Phosphorus (mg/plant)	Potassium (mg/plant)	Reducing sugar (g/100 g dry weight)	Non-reducing sugar (g/100 g dry weight)	Total sugars (g/100 g dry weight)
					Season 1987/1988			
99	32	36	1722	341	1441	8.43	3.32	11.75
99	48	48	2411	543	2341	9.12	3.56	12.68
99	64	72	2405	587	2658	9.95	3.96	13.91
L.S.D. at 5%			54.38	22.92	61.45	0.06	0.04	0.09
					Season 1988/1989			
99	32	36	1653	327	1378	7.74	3.18	10.92
99	48	48	2313	509	2238	8.34	3.45	11.79
99	64	72	2270	561	2558	9.08	3.88	12.96
L.S.D. at 5%			107.18	14.27	36.06	0.05	0.04	0.08

pronounced effect in this respect at both winter seasons of 1987/1988 and 1988/1989. However, no significant differences between the 2nd and 3rd levels could be detected regarding the total nitrogen content at both seasons of growth.

These results may be explained on the base that treatments showed the lowest plant growth expressed as fresh and dry weight per plant were those received the lowest fertilizers level (Table 2), which also resulted in plants of the lowest mineral and sugars content of plant. However, plants fertilized with the highest used level of fertilizers, which were of medium fresh and dry weight (Table 2), were those containing the highest minerals and sugars content. Such findings show clearly and may be due to the balance between growth and plant uptake of N, P and K as well as sugars percentage.

With regard to the effect of interaction between seed-cold treatment and fertilization rate of phosphorus and potassium, it is evident from data in Table (6) that third used level of fertilizers (99 kg N + 64 kg P_2O_5 + 72 kg K_2O/fad.) combined with seed-cold treatment at -3°C for 24 hours followed by -2°C for 24 hours resulted in the highest values of N and P contents in plants foliage. However, treatment of third used level of fertilizers combined with seed-cold exposure at -2°C for 24 hours and that of -1°C for 24 hours showed the highest K content in plant foliage.

Similar results were obtained by Zurawicz and Stushnoff (1977) on strawberry where they reported that N, P and K contents of vegetative plant parts were increased as a result of exposing plants to -2.2°C for the tender plants and received 1:1:1 or 1:2:1 ratios of NPK fertilizers. They also found that, N:P:K ratio is more important than the level of any individual element.

Moreover, Eid *et al.* (1988), on broad bean showed that, nitrogen and phosphorus at 33.5 kg N/fad. and 16 or 32 kg P_2O_5/fad. as well as seed vernalization for one week at 5°C were the most effective treatment on plant foliage mineral contents of N, P and K.

Concerning the effect of interaction between both of the two main used factors on reducing, non-reducing and total sugars content of plant foliage, it is evident that the highest used level of fertilizers (99 kg N + 64 kg P_2O_5 + 72 kg K_2O/fad.) combined with seed-cold treatment

Table (6): Effect of interaction between seed-cold treatment and fertilization on chemical composition of tomato plant foliage.

Levels of fertilizer			Seed-cold treatment		Season 1987/1988						Season 1988/1989					
N	P_2O_5	K_2O	Temperature	Time	Total nitrogen	Phosphorus	Potassium	Reducing sugars	Non-Reducing sugars	Total sugars	Total nitrogen	Phosphorus	Potassium	Reducing sugars	Non-reducing sugars	Total sugars
	(kg./Fad.)		°C	hrs.	mg/plant			g/100 g dry weight			mg/plant			g/100 g dry weight		
99	32	36	Control		1728	302	1275	7.20	1.57	8.77	1698	296	1250	6.49	1.60	8.09
			-1	12	1604	320	1259	10.15	4.11	14.26	1567	307	1224	9.39	3.77	13.16
				24	1680	292	1413	10.58	4.50	15.08	1606	275	1318	9.75	4.30	14.05
			-2	12	1451	309	1366	9.55	3.93	13.48	1412	301	1333	8.86	3.84	12.70
				24	1571	352	1605	8.27	3.55	11.82	1502	339	1568	7.48	3.32	10.80
			-3	12	1963	400	1468	6.39	2.70	9.09	1860	372	1323	5.90	2.63	8.53
				24	2063	412	1704	6.91	2.92	9.83	1929	400	1630	6.35	2.81	9.16
99	48	48	Control		2446	438	1827	7.76	1.98	9.74	2300	401	1723	7.07	1.83	8.90
			-1	12	2170	521	2245	10.71	4.45	15.16	2089	501	2158	9.71	4.19	13.90
				24	2479	468	2563	11.18	4.72	15.90	2316	447	2449	10.29	4.64	14.93
			-2	12	2143	497	2257	10.30	4.16	14.46	2018	464	2126	9.54	4.07	13.61
				24	2469	574	2612	9.11	3.60	12.71	2353	553	2515	8.19	3.61	11.80
			-3	12	2655	630	2844	6.95	2.88	9.83	2508	595	2829	6.35	2.74	9.09
				24	2517	676	2042	7.85	3.15	11.00	2608	606	1868	7.24	3.09	10.33
99	64	72	Control		2135	473	2113	8.32	2.47	10.79	2071	397	2047	7.57	2.51	10.08
			-1	12	2169	607	2738	11.56	4.79	16.35	2109	590	2662	10.52	4.64	15.16
				24	2378	499	2950	11.99	5.01	16.00	2301	483	2855	11.00	5.03	16.03
			-2	12	2139	502	2413	11.09	4.50	15.59	2055	496	2311	10.16	4.41	14.57
				24	2775	643	3003	9.83	4.05	13.88	2669	643	2888	9.12	3.84	12.96
			-3	12	2462	654	2905	7.85	3.21	11.06	2173	602	2730	7.07	3.09	10.16
				24	2760	737	2487	9.02	3.71	12.73	2512	717	2417	8.14	3.66	11.80
L.S.D. at 5%					139	34	176	0.25	0.03	0.20	185	37	216	0.26	0.04	0.17

at -1°C for 24 or 12 hours showed significant increments in this respect. These incrmenets were obvious at both growing seasons of 1987/1988 and 1988/1989.

Obtained results are in agreement with those obtained by ledov'skii and Bondarenko (1974) on tomato and Pollock and Llyd (1987) on pea.

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تأثير معاملة البذور بالبرودة ومعدل الأسمدة الفوسفاتية والبوتاسية على النمو والتركيب الكيماوى لنباتات الطماطم

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أجريت تجربتان حقليتان بمزرعة كلية الزراعة بمشتهر جامعة الزقازيق خلال الموسم الشتوى لعامى ١٩٨٨/٨٧ ، ١٩٨٩/٨٨ على الطماطم صنف يوسى ٩٧ - ٣ ٠ لدراسة تأثير تداخل فعل ثلاث مستويات مختلفة من الأسمدة الفوسفاتية والبوتاسية مع سبعة معاملات للبذور بالبرودة على النمو والتركيب الكيماوى للنباتات ٠

وقد اتضح من النتائج المتحصل عليها أن حفظ البذور عند درجة ٣ لمدة ٢٤ ساعة مع التسميد بالمستوى الثانى من الأسمدة (٩٩ كم ن + ٤٨ كجم فو$_2$أ$_5$ + ٤٨ كجم بو$_2$ أ / فدان) أعطى أعلى نمو خضرى وأعلى محتوى من النتروجين والفوسفور والبوتاسيوم بالنبات الا أن السكريات المختزلة والغير مختزلة والكلية كانت عند أعلى قيم لها عند التسميد بنفس المستوى ولكن عند برودة ١ $^{\circ}$م ولمدة ٢٤ أو ١٢ ساعة ٠