RESULTS AND DISCUSSION

I. Effects of Water Regime and Different Concentrations of (PBA) and (NPA) on Vegetative Growth of Capsicum annuum L.:

I.1. Number of branches per plant :

Data in Table (1) of the first season (1981), obviously show that water regime had different effects on the number of branches carried on Capsicum annuum plants. Treatment E (irrigation every 15 days with half quantity of water needed for 100 % F.C.), at 0.0 cytokinins concentration resulted in the highest number of branches. Branch number in this case was 37.6 % more than treatment A (irrigation every 5 days to attain 100 % F.C.) which gave 165.7 branches/ plant although the difference in this respect was not significant. Treatments B (irrigation every 10 days to attain 100 % F.C.) and C (irrigation every 10 days with half quantity of water needed for 100 % F.C.) followed E in the number of branches carried on the plant as 214 and 204.3, respectively. Whereas treatment D (irrigation every 15 days to attain 100 % F.C.) gave the moderest number of branches per plant as 193.

Table (1) : Effect of water regime and different concentrations of (PBA) and (NPA) on the number of branches/plant of *Capsicum annuum* L.

GR * / Conc. ** / Irr. ***	Season (1981)					Season (1982)				
		PBA		NPA			PBA		NPA	
	0.0	100	200	100	200	0.0	100	200	100	200
A	165.7	179.3	185.7	205.0	160.3	96.9	116.2	113.1	105.3	92.8
B	214.0	263.0	171.7	133.0	130.7	125.9	135.8	119.7	143.5	142.3
C	204.0	203.3	231.3	176.0	186.0	114.8	103.8	112.3	120.4	120.3
D	193.0	227.0	234.3	223.0	145.0	141.4	159.4	161.9	156.5	155.8
E	228.0	231.3	255.7	212.0	180.7	143.9	129.8	146.0	156.4	152.3
F	174.7	219.7	258.0	166.0	164.3	136.4	134.4	145.9	162.7	138.2

L.S.D.		Irr.	GR.	Conc.	GR.x Irr.	Irr.x Conc.	GR.x Conc.	GR.x Irr.x Conc.
1981	5 %	N.S.	17.2	N.S	N.S	N.S	25.2	N.S
	1 %	N.S	23.8	N.S	N.S	N.S	34.0	N.S
1982	5 %	20.4	18.8	N.S	N.S	N.S	N.S	N.S
	1 %	29.0	26.0	N.S	N.S	N.S	N.S	N.S

* Growth regulators
** Concentration
*** Irrigation.

On the other side, both treatments (A) and (F) gave the least number of branches per plant. Frequent watering at 5-day intervals seriously retarded branch ing even when compared with the longer irrigation interval water regime (F) treatment. Data in (1982) show similar trend on results as those of first season.

In both cases when water stress happened, with treatment (A) it was due to logging, with treatment (F) this was due to drought.

These forms of stresses as poor aeration and nutritional deficiencies due to more of minerals in the first case (logging) and drought in the second case lead to changes in water potentials.

The plant's reaction to moisture stress embodies both physical and physiological components. The effect of water stress on physical side was indicated by Slatyer (1967). Earlier work of Gardner and Nieman (1964) on pepper showed close agreement in this respect, Huck *et al.* (1970) found that tissue shrinkage known to accompany the cessation in cotton-root extension, accentuates the plant's difficulties in meeting transpirational demands because vapor gabs develop between root surfaces and soil particles. If the plant's demands for water are not met, turgor is lost and leaves (especially old ones) adopt a wilted appearance. This case was visually noticed with both treatments, consequently a reflaction on the growth was true.

Raschke (1970) showed that before any visual expression of moisture stress (wilting) physiological reactions to moisture stress have already occurred. Also, a further suggestion of metabolic involvement in plant water relations was shown during recovery from moisture stress. Such after-effects of moisture stress are widely recognized. Fischer et al. (1970) reported that depression in stomatal response to light following moisture stress, the after-effect was proportional to leaf water deficit immediatly before rewatering.

Water stress in plant tissues resulting from drought cause an increase in ABA and decrease of in that of cytokinins (Itai and Vaadia, 1965, Itai and Vaadia 1971 and Zeevart, 1971).

The same type of increases with water stress have subsequently been reported for quite a wide range of plant species (Wright and Hiron, 1972, and Milborrow, 1972). Water logging and poor aeration give similar effects (Wright and Hiron, 1972). There is some evidence for a balancing between cytokinins and ABA in the regulation of stomatal behavior (Mizrahi et al., 1970).

Also, the availability of minerals in both cases might be a **reason** for the growth retardation expressed as number of branches on the plant. The physiological activities of root decrease with the excess of water which affects aeration. Consequently both mineral and water absorption will be minimized similarly as drought influence.

Similar conclusion was reported by **Mizrahi** and Richmond (1972). In the second case, drought will affect the growth through the lack of water needed for physiological and biochemical reactions. The effect of drought on growth of plants was reported by Ong **(1978)** **who found that water stress injury of tomato cotyledons** was associated with increases in larger molecules and decreases in the smaller ones. These changes could be explained by the reduction of endogenous cytokinin activity by the water stress. Also, showing lower stress and reduction in cytokinin activity leading to an increase in enzyme activity involved in the hydrolysis of proteins and RNA and a decline in enzyme activity involved in the hydrolysis of carbohydrates.

With all water regime treatments except treatment C, data in Table (1) indicate that spraying with PBA at concentration of 100 ppm. increased the number of branches carried on pepper plants.

Under the irrigation regime F, the increase was 25.7 % over the untreated plants. In (1982) the increases due to 100 ppm applications were coincided with treatments A, B and D.

In both season spraying the concentration of PBA to 200 ppm increased branching with all water regime treatments except with (C) treatment. The percentages of increases were 12, 13.2, 21.4, 12.1 and 47.7 %,respectively for water regime treatments A, C, D, E and F in (1981). These results indicate that the growth regulator (PBA) had great influence on increasing branching, especially with pepper plants subjected to drought.

Obvious from data in (1981) that PBA had different trends in its influence on branching of pepper plants as compared with NPA. Spraying plants with (NPA) at 100 ppm decreased the number of branches/plant when the plants were subjected to water regimes of B, C, E and F treatments in (1981). The effect was more clear with B and C water regimes in which the percentages of decreases attained 37.8 and 13.7%, respectively as compared with the untreated plants. In 1982 NPA at 100 ppm increased branching of treated plants. The increases due to 100 ppm application were noticed with treatment A, B and C.

On the other side, percentages of increases of pepper plants grown under A and D water regimes and treated with 100 ppm of (NPA) were 23.7 and 15.5, respectively. The first percentage has a meaning of correcting the logging effects on branching.

With all water regimes, it is clear from data in (1981) and (1982), that spraying <u>Capsicum annuum</u> plants with (NPA) at 200 ppm level-in most cases-decreased the number of branches/plant as compared to the untreated plants. The least number of branches was recorded with the water regime B (irrigation every 10 days to attain 100 % F.C.) coincided with 200 ppm spraying of NPA in (1981) and treatment (B) in (1982).

The interaction GR.X conc. which was significant in (1981) indicates that correcting the influences of either water logging or drought may be attained by selecting the growth regulator with its suitable concentration.

I.2. Number of fruits per plant :

Data in Table (2) of (1981) show that the maximum number of fruits/plant of C. annuum as 104.7 was obtained from water regime (A) followed by (B) then (D). This would indicate that the number of fruits/plant decreased with the shortage of available water. Exception from treatment (C), this trend was true and the number of fruits was seriously depleted with the highest water stress represented by (F) water regime.

Treatment (A) gave number of fruits over 400 % of that recorded from treatment (F), however, Table (2) in (1982) shows different trend in this respect. The increase was significant in 1981. Extension growth in shoots and roots, leaf expansion, organ enlargement and stomatal function are all clearly coupled to moisture status. Hafeez and Gornillon (1976) studed the effects of irrigation rhythm on growth, fruit-set, yield and quality of egg plant (Solanum melongena). They found that fruit number was greatest with 5 irrigations per week, less with 2 per week, and least with one per ten days.

Kramer (1969) stated that water stress produces considerable changes in the course of protein synthesis and

Table (2) : Effect of water regime and different concentrations of (PBA) and (NPA) on the number of fruits/plant of *Capsicum annuum* L.

	Season (1981)					Season (1982)				
G R*	PBA			NPA		PBA			NPA	
Conc.** / Irr.***	0.0	100	200	100	200	0.0	100	200	100	200
A	104.7	133.0	48.3	74.2	11.1	30.7	21.9	29.9	23.9	17.2
B	88.4	97.2	21.8	21.3	14.1	42.7	43.0	36.1	34.6	30.0
C	45.8	65.4	76.1	28.6	20.1	35.4	30.2	34.9	26.8	27.1
D	81.7	92.0	44.2	52.2	31.7	39.2	38.2	48.9	39.1	40.2
E	57.2	74.5	78.3	43.6	22.2	51.8	32.5	42.9	31.9	44.3
F	23.7	40.8	88.7	29.1	16.0	29.7	34.7	32.4	27.5	15.9

L.S.D.		Irr.	G R	Conc.	G R.x Irr.	Irr.x Conc.	G R. x Conc.	GR.x Irr.x Conc.
1981	5 %	19.3	24.6	15.2	N.S	N.S	21.5	15.2
	1 %	27.2	34.1	20.0	N.S	N.S	28.9	20.4
1982	5 %	6.86	N.S	N.S	N.S	N.S	N.S	N.S
	1 %	9.76	N.S	N.S	N.S	N.S	N.S	N.S

* Growth regulators.
** Concentration.
*** Irrigation.

it seems possible that water stress greatly accelerates the changes normally associated with senescence. Todd and Yoo (1964) reported a decrease in the activity of several enzymes in detached wheat leaves subjected to water stress.

Similar results on tomato cotyledon were reported by Ong (1978) who found initially injured by water stress, lower levels of proteins and RNA during the first 4 days. Later they adapted to stress and showed increased values of these compounds above those in normal cotyledons. The results indicate that the changes in cytokinin activity play afundamental role in the response of cotyledons to water stress.

The application of PBA at the concentration of 100 ppm gave noticeable increases in the number of fruits carried on the plant of C. annuum L. (Table (2) in (1981). Percentages of increases over the untreated plants were 27 % 9 %, 42 %, 12 %, 30 % and 72 % for water regime A, B, C, D, E and F, respectively. The results of the two seasons showed that the greatest influence was with plants subjected to drought treatment F. It means that PBA probably has some role in correcting the bad influence of water stress (drought) on fruit set. Statistical analysis proved significance in this respect in (1981).

When the concentration of PBA was raised to 200 ppm then applied on pepper plants grown under different water regimes, different results were attained as shown in Table (2) (1981, 1982).

This concentration enormously increased, the percentage of fruit set on the untreated plants grown under (F) water regime treatment (Table 2). This result seems to have great importance because such application may correct the flower and fruit drop in crops grown under similar drought conditions.

Cytokinins were found to increase fruit-set when applied to figs (Crane and Overbeek, 1965). Also, Jones 1965 found that cytokinins improved the fruit setting of pollinated cucurbits.

On the other side, the (A) and (B) water regime with 200 ppm of PBA showed noticeable decrease in the number of fruit set (Table 2). Hence, PBA at high concentration may be advised only for plant grown under water stress (drought) if increased number of fruits is aimed.

As for NPA, data in Table (2) indicate that this growth regulator at the proposed concentration has a deteriorating effects on the fruit-set of pepper grown under similar conditions of the experimented water regimes.

I.3. Fresh weight of whole plant in:

Table (3) presents the data obtained for the differences in fresh weight of plant in gms as affected by water regime and cytokinins applications. The highest fresh weight of plant was recorded from plots (D) where the plants were irrigated every 15 days to attain 100 %. F.C. The mean fresh weight of a plant in this case was 159.0 gms compared with the least one as 99.1 gms from treatment (C) where plants were irrigated every 10 days with half quantity of water needed to attain 100 % F.C. Generally data show that the fresh weight of the whole plant was increased with (D) and (E) irrigation every 15 days to attain 100 %. F.C. and irrigation every 15 days with half quantity of water needed for 100 % F.C. Also, treatment F (irrigation every 20 days to attain 100 % F.C. gave higher fresh weight than plants of (A) treatment (irrigated every 5 days to attain 100 % F.C.) which gave 136.8 gms/plant. In this respect, it seems that decreasing water supply increased fresh weight of plant, but in the meantime contradictory influence was noticed with fruit yield. It is possible that plants may grow vegetatively better under drought conditions but the shortage of water will reflect on both fruit

Table (3) : Effect of water regime and different concentrations of (PBA) and (NPA) on the fresh weight of plant (gms) of <u>Capsicum annuum</u> L.

	Season (1982)				
G R.*		PBA		NPA	
Irr.*** / Conc.**	0.0	100	200	100	200
A	136.8	97.9	119.0	87.2	99.0
B	145.8	162.2	144.2	163.3	121.8
C	99.1	111.4	113.4	133.4	132.6
D	159.0	220.3	224.8	208.4	228.2
E	150.9	131.3	140.3	146.1	161.0
F	141.4	147.2	117.7	120.7	148.4

L.S.D.		Irr.	GR.	Conc.	GR. x Irr.	Irr.x Conc.	GR x Conc.	GR x Irr.x Conc.
1982	5 %	24.9	N.S	N.S	N.S	N.S	N.S	N.S
	1 %	27.4	N.S	N.S	N.S	N.S	N.S	N.S

* Growth regulators.
** Concentration.
*** Irrigation.

set and development. For this reason, adequate supply of water as (D) treatment is needed for better crop of pepper. Comparing the moisture content of the soil just before irrigation, it is noticed that D treatment gave 62.0 % compared control 75.9 %.

Table (3) shows that (D) treatment gave 220.3 compared to 97.9, 162.2, 111.4, 131.3, and 147.2 gms/plant for treatments A, B, C, E and F respectively.

The use of PBA at 100 ppm concentration increased the fresh weight of plant grown under different water regimes except with A and E treatments. The most promising effect was noticed with treatment (D) where the mean fresh weight increased by 38.5 % compared with 28.4 % decrease in the weight of plants from treatment (A). The increasing and decreasing effects were statistically insignificant.

Regarding the other treatments, the change in the weight of plants due to the same concentration was slight.

The concentration 200 ppm of PBA showed increasing effects with (D) and (C) treatments as 41.3 % and 14.4 % respectively as compared with their controls.

Some decreasing effects on the weight of plants can be noticed in Table (3) due to the application of 200 ppm concentration within a range of 1 % to 16 %. The decreases were insignificant.

From the above results, PBA used at 200 ppm can benifit the plant growth when adequate water as treatment (D) is given to pepper plants.

Similar results were reported by Meconnell & Pool(1973).They found that growth of Scindapsus aureus plants was responsive to PBA at 100-400 ppm.

Concerning the effect of NPA on the fresh weight of pepper plant data in Table (3) indicate that the concentration 100 ppm significantly increased the fresh weight of plants grown under water regimes B, C and D treatments.

The increasing percentages in order were 12 %, 34.6 % and 31 % over their controls. The effect of the same concentration on the plants of the other treatments was negative. With 200 ppm concentration of NPA results in Table (3) show obvious increase in the weight of plants of treatment (D). This application represented 43.5 % increase over its control. Also, this concentration increased the vegetative growth of plants grown under water regimes treatments C, E and F by 33.8 %, 66 % and 4.9 % respectively. However, these increases were insignificant.

These results indicate that NPA can be advised for application at this concentration (200 ppm) for better vegetative growth if such growth is coincided with better fruiting.

The action of NPA in this respect can be explained by its stimulating effects on increasing branching and its effects on increasing carbohydrates synthesis.

Similar findings were reported by Ong (1978) who found that addition of kinetin reversed the effects of water stress on enzyme activities. It was concluded that during water stress injury, there was a reduction in cytokinin activity leading to an increase in enzyme activity involved in the hydrolysis of proteins and RNA and a decline in enzyme activity involved in the hydrolysis of carbohydrates.

I.4. Fresh weight in gms. and dry weight percentage of leaves :

The comparison of water regime treatments in Table (4) shows that in (1981) the heaviest fresh weight of leaves was recorded from (A) treatment. This treatment increased the weight by about 46 % over the moderate irrigation level of (C).

Plants of treatment (F) grown under water stress gave the least fresh weight in (1981) and the highest one in (1982). Treatments D, E and F, gave comparatively higher fresh weights of leaves as compared with treatments receiving abundant quantity of water (1982). Also, it could be recognized that the least dry weight percentage was recorded in 1981 from plants grown under (A) level of irrigation where plants received frequent irrigation.

Generally, minimizing water supply resulted in higher percentage of dry weight in leaves of pepper as shown (5).

Regarding the effects of PBA when combined with water regime treatments it is clear from data in Table (4) that 100 ppm gave increases in the fresh weight of leaves of

Table (4) : **Effect of water regime and different concentrations of (PBA) and (NPA) on the fresh weight of leaves/plant of <u>Capsicum annuum</u> L. (gms).**

	Season (1982)				
GR *	PBA			NPA	
Conc. ** / Irr. ***	0.0	100	200	100	200
A	42.2	35.5	41.4	22.5	32.8
B	53.9	51.9	55.4	69.9	42.0
C	37.8	45.1	44.7	59.0	50.6
D	56.9	70.3	72.9	86.5	88.6
E	64.0	57.5	73.9	56.1	70.6
F	68.0	76.2	55.7	61.3	66.9

L.S.D.		Irr.	GR.	Conc.	GR x Irr.	Irr. Conc.	GR x Conc.	GR x Irr. x Conc.
1982	5 %	14.1	N.S	N.S	N.S	N.S	N.S	N.S
	1 %	20.0	N.S	N.S	N.S	N.S	N.S	N.S

* Growth regulators.
** Concentration.
*** Irrigation.

Table (5) : Effect of water regime and different concentrations of (PBA) and (NPA) on the dry weight percentage of leaves/ plant of Capsicum annuum L.

	Season (1982)				
GR.*		PBA		NPA	
Irr.*** / Conc.**	0.0	100	200	100	200
A	23.2	21.9	22.2	21.7	21.9
B	22.3	22.4	23.1	23.2	21.4
C	20.6	21.5	20.2	22.2	20.2
D	21.8	22.1	21.5	21.6	21.3
E	21.0	23.7	23.5	22.5	20.5
F	23.0	21.0	23.3	22.3	22.2

* Growth regulators.
** Concentration.
*** Irrigation.

plants grown under water regimes (C) and (F). In (1981) the increases were 126 % and 138 % respectively over their control treatments. In the meantime with the other water regime treatments, results showed decreasing effects. The same trend was true in 1982, besides an increasing effect with treatment (D).

With the concentration 200 ppm, the fresh weight of leaves was obviously increased for B, C, D, E and F as compared with control in (1981). The same trend was noted in B, C, D and E treatments in (1982). These results indicate that PBA had favourable effect on increasing the fresh weight of leaves of pepper, especially at 100 ppm, concentration. It is a point of interest to mention that with more water frequency, PBA reduced the fresh weight of leaves, hence, a proper supply of water coincided with PBA application as 100 ppm may be advised for better growth of pepper.

Results in Table (4) also show that NPA gave its best effect at the application of 100 ppm concentration on plants grown under water regime (B), at 200 ppm with water regime (D) in (1981) and (1982).

It seems that NPA may be applied at 100 ppm with water regime like (D) (irrigation every 15 days to attain 100 % F.C. the amount of water, equals 4300 M^3/ per feddan.

Regarding the effects of PBA and NPA on the dry weight percentages in leaves it is clear from data in Table (5) that both growth regulators generally increased the dry weight percentages in plants grown under water regime (A) in (1981).

With water regime (C), NPA showed remarkable decrease in dry weight percentage when plants were treated with 100 ppm PBA in (1982). This was the same treatment which produced the heaviest fresh weight of leaves as shown in Table (4).

Comparing this treatment with that of plants grown under water regime (E) and treated with BBA as 200 ppm it is clear the later gave the highest percentage of dry matter as 23.7 %.

The other treatments in (1981) and (1982) gave different trends and both growth regulators did not show special trend with any of water regime treatments.

Generally, it could be concluded that adequate water supply combined with 100 ppm sprays of cytokinins especially PBA would benefit the vegetative growth of pepper. The action of cytokinins on increasing fresh weight of vegetative growth was explained by Mikulovich and Kulaeva (1977), who found that cytokinin stimulated the growth of cotyledons and increased the DNA content,and had effect on division of cells, chloroplasts and mitochondria.

Some other investigators showed that water supply in suitable amounts reflects on vegetative growth through water effects on turgidity, photosynthesis and enzyme activity.

Hoare and Barrs (1975) studied the effect of different degrees of water stress. Data were presented on plant responses in terms of changes in leaf water potential, transpiration and photosynthesis. With all plant species tested (capsicums, melons and orange), mesophyll resistance and stomatal resistance rose with increasing stress and were associated with declining photosynthesis.

Roth _et al_. (1970) found that the water balance of the plant is a major factor affecting the endogenous level of cytokinin, which seems to be suboptimal in summer plants and optimal in winter plants. Summer tobacco responds to exogenous applications of kinetin, winter grown plants respond when kept in an atmosphere of high relative humidity.

Consequently, different directions of plant metabolizm could be reached through the exogenous applications of growth regulators like cytokinins.

1.5. Fresh weight . in gms and dry weight percentage of stems :

The heaviest weight of stems was given by the plants of pepper irrigated by B water regime in (1981) and (D) water regime in (1982) as shown in Table (6). Treatment (B) water supply as (irrigation every 10 days to attain 100 % F.C.) gave 218 gms of stems/plant compared to 129 gms. for D (water supply as irrigation every 15 days to attain 100 % F.C.). For the results of the two treatments noted in (1982), D treatment gave the highest fresh weight. Hence, it can be concluded that although the fresh weight of stems may be influenced by water regime other factor as temperature may interact to give different trends.

The dry weight percentage as shown in Table (7) did not show noticeable changes due to water regime influences except the increases in both seasons due to water stress with treatments (E) and (F). These results were similar to those with the dry weights of leaves. This might be explained by the more turgidity and water content in plants frequently irrigated or those supplied with higher quantities of water as treatment (A).

Table (6) : Effect of water regime and different concentrations of (PBA) and NPA on the fresh weight of stems/plant gms of <u>Capsicum annuum</u> L.

(Season 1982)					
GR.*		PBA		NPA	
Irr.*** / Conc.**	0.0	100	200	100	200
A	87.8	56.0	69.1	54.3	55.3
B	81.4	90.0	80.2	81.1	67.4
C	55.5	56.6	63.0	66.7	74.5
D	92.8	131.5	131.8	109.7	124.7
E	77.0	64.4	59.5	70.4	81.7
F	65.7	63.7	55.1	49.3	70.2

L.S.D.		Irr.	GR.	Conc.	GR. x Irr.	Irr.x Conc.	GR. x Conc.	GR.xIrr.xConc.
1982	5 %	12.8	N.S	N.S	N.S	N.S	N.S	N.S
	1 %	18.2	N.S	N.S	N.S	N.S	N.S	N.S

* Growth regulators.
** Concentration.
*** Irrigation.

Table (7) : Effect of water regime and different concentrations of (PBA) and (NPA) on the dry weight percentage of stems of <u>Capsicum annuum</u> L.

	Season (1982)				
GR.*	PBA			NPA	
Conc.** / Irr.***	0.0	100	200	100	200
A	22.0	22.3	23.2	21.4	23.7
B	22.1	23.8	22.6	21.6	22.3
C	20.0	23.2	22.4	22.8	21.4
D	22.0	22.9	22.0	22.1	24.1
E	23.9	24.7	23.9	20.2	23.4
F	23.6	23.1	23.6	25.7	23.4

* Growth regulators.
** Concentration.
*** Irrigation.

Data concerning the effects of growth regulators in Table (6) indicate that PBA at 100 ppm concentration apparently increased the fresh weight of stems of plants grown under the different experimented water regimes. Whereas in (1981) and (1982), the most increase was with 100 ppm x water regime (D), slight decreases were noticed with water regime A, E and F in (1982).

With PBA at 200 ppm concentration the most increases were recorded from combinations with water regimes C,D,E and F in (1981). These increases (over control) were 62.8 %, 120.5, 48.3 % and 46.7 %, respectively. In 1982, this concentration was only effective with plants subjected to water regime (D) as shown in Table (6).

With water regime (C), slight increase is noticed in the same season due to the growth regulator application.

Generally, the application of NPA at both concentrations 100 and 200 ppm gave remarkable increase in the fresh weight of stems. However, the effect of NPA on the plants grown under drought conditions was not clear because the trend differed in both seasons.

These results show that cytokinins can benifit the stem growth by increasing branching especially for plants grown under moderate supply of water. Similar results were reported by Mikulovich and Kulaeva (1977) they found that cytokinin stimulated the growth of cotyledons.

Jeffcoat (1977) found that foliar sprays with PBA increased branching in carnation, chrysanthemums, poinsettia, petunias and fuchsias.

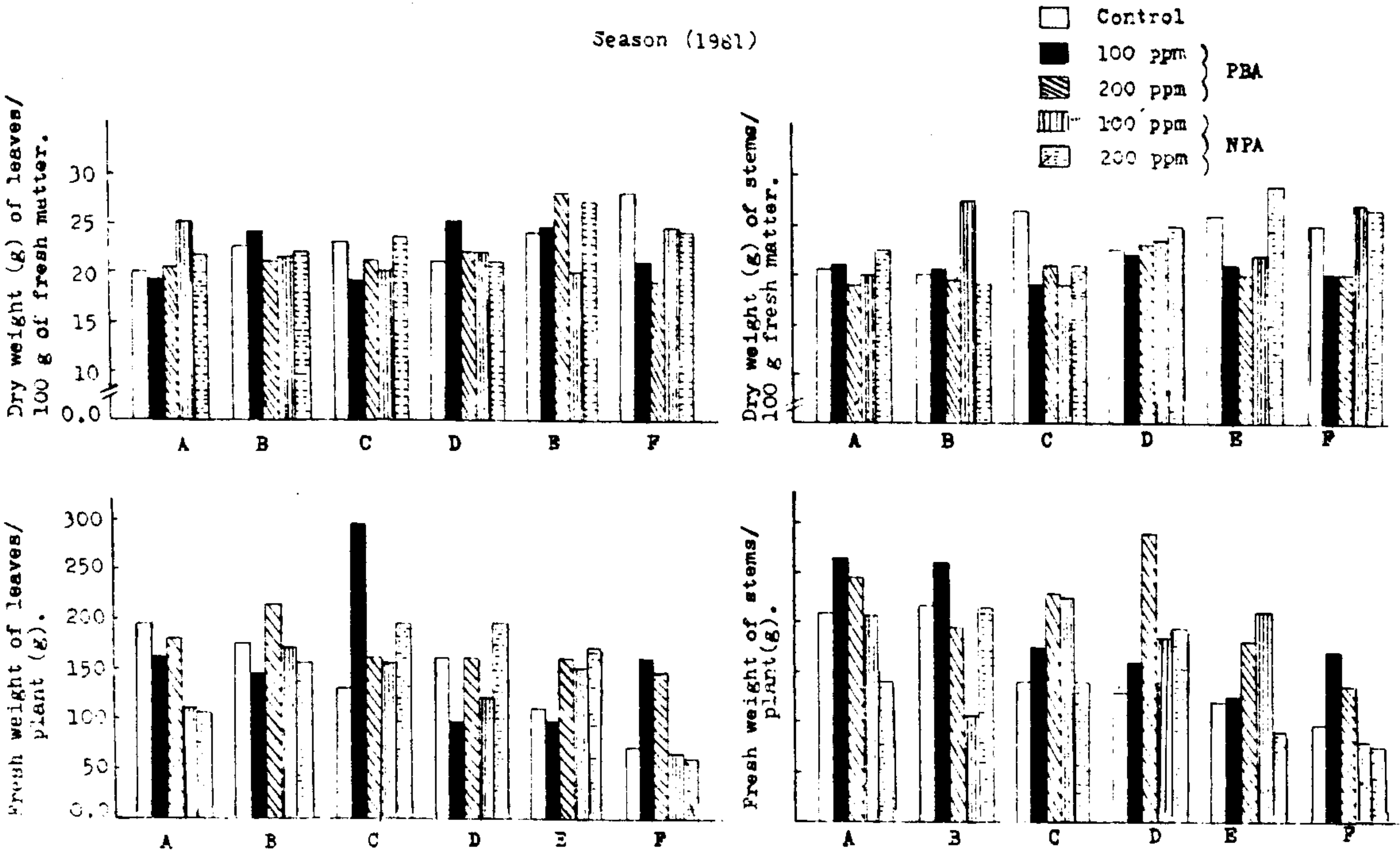

Fig. (1) : The effect of water(A, B, C, D, E and F) treatments.

1.6. Fresh weight in gms and dry weight percentage of fruits:

Results in Table (8) of the first season (1981) show that the highest yield as 219.5 gms fresh weight of fruits per plant of C. annuum was obtained from plots treated with water regime A (irrigation every 5 days to attain 100 % F.C.). The increase was highly significant especially when compared with treatment of F plots (irrigation every 20 days to attain 100 % F.C.). The increase in the yield of A treatment was 368 % over that of F treatment indicating that water is the most important factor in increasing the yield of pepper.

The same trend can be observed in the data of 1982 represented in Table (8). Similar results were obtained by Quagliotti (1971) who found that the yield of capsicum fruit gave a positive response to increasing amounts of irrigation. Also, on capsicum Borelli and Zebi (1978) found that total and commercial yield was greatest with the most frequent irrigation and least with least frequent irrigation.

Table (8) : Effect of water regime and different concentrations of (PBA) and (NPA) on the fresh weight of fruits/plant in gms. of <u>Capsicum annuum</u> L.

	(Season 1981)					(Season 1982)				
GR.*	PBA			NPA		PBA			NPA	
Irr.*** / Conc.**	0.0	100	200	100	200	0.0	100	200	100	200
A	219.5	189.4	103.0	85.1	29.8	153.2	137.3	179.7	122.2	110.3
B	82.8	153.4	36.6	33.7	31.0	143.2	241.6	184.4	190.2	146.3
C	104.3	101.8	152.0	87.0	55.8	60.1	50.7	56.0	60.3	57.7
D	116.0	149.7	59.9	81.1	61.0	107.2	185.7	206.8	159.4	174.6
E	93.8	90.3	97.2	86.9	45.8	91.3	53.2	61.6	63.4	61.1
F	46.9	48.3	105.8	41.1	24.9	47.1	49.6	42.1	37.5	31.1

L.S.D.		Irr.	GR.	Conc.	GR.X Irr.	Irr.x Conc.	GR. x Conc.	GR.x Irr. x Conc.
1981	5 %	10.7	30.83	13.9	N.S	34.03	19.6	13.8
	1 %	15.2	42.64	18.5	N.S	45.9	26.5	18.4
1982	5 %	12.9	N.S	N.S	N.S	N.S	N.S	N.S
	1 %	17.34	N.S	N.S	N.S	N.S	N.S	N.S

* Growth regulators.
** Concentration.
*** Irrigation.

Table (9) : Effect of water regime and different concentrations of (PBA) and (NPA) on the dry weight percentage of fruits of <u>Capsicum annuum</u> L.

	Season (1981)					Season (1982)				
GR.*		PBA		NPA			PBA		NPA	
Irr.*** / Conc.**	0.0	100	200	100	200	0.0	100	200	100	200
A	17.4	21.6	15.7	18.9	18.8	11.3	11.7	9.5	10.4	11.2
B	23.0	19.5	18.6	16.6	18.1	15.5	8.1	12.8	15.7	12.7
C	17.9	18.8	18.9	13.3	14.9	17.0	17.8	18.4	16.1	14.8
D	20.3	16.7	16.6	18.1	17.5	12.1	10.7	11.0	10.9	11.3
E	19.1	19.5	20.1	16.8	19.2	18.8	20.4	21.5	17.5	16.4
F	17.7	20.5	18.5	20.9	19.3	17.9	20.6	22.5	15.2	19.4

* Growth regulators.
** Concentration.
*** Irrigation.

Apart from the above difference, although the previous data in Table (1) showed that treatment A resulted in fewer number of branches, data in Table (8) indicate that the fresh yield weight was not dependent on the number of branches carried on the plant.

It seems that the percentage of fruit set is the principal factor affecting the yield, water has a main role on increasing the number of fruit set. The was indicated by Hafeez and Gornillon (1976) they studed effects of irrigation rhythm on growth, fruit set , yield and quality of egg plant (Solanum melongend.). They found that fruit number and fruit fresh weight were greatest with 5 irrigations per week, less with 2 per week, and least with one per ten days.

Treatments C (irrigation every 10 days with half quantity of water needed for 100 % F.C.) and D (irrigation every 15 days to attain 100 % F.C.) followed treatment A in the increased yield as fresh weight of fruits per plant. However, the yield per plant from treatment A was nearly double that of C or D. Water regime E (irrigation every 15 days with half quantity of water needed to attain 100 % F.C.) gave low yield as compared to A, but it was twice much as that of treatment F which significantly resulted in the least crop. Also, data in Table (1) which previously showed that E treatment gave the most number of branches, in Table (8) the crop of fresh weight per plant from the same treatment is obviously low. This confirms that branching is not the main factor controlling the yield of pepper.

In season (1981), the decrease in the yield of treatment B seems to be due to other factors rather than water regime.

In (1982), the same treatment gave the second highest yield supporting the opinion that adequate watering is needed for better crop of pepper.

These results were in agreement with those reported by Berenyi (1970) on red pepper who found that irrigation increased both fruits weight and size. Also, Kartalov and Dimitov (1970) reached the highest yield of capsicum when the soil moisture was maintained at 80-90 % of field capacity. The results stated by Berenyi (1976) showed that irrigation increased the capsicum fruit yields of both direct sown and transplanting crops.

Strelec and Cerna (1976) found that the highest yields and greatest returns of capsicum plants were produced when plants were irrigated at 80 % F.C. Also, on tomatoes, Zhabina & Osipenko (1975) found that irrigation of the soil to a constant level of 70-80 % moisture increased the yield and weight of tomatoes by 32.7 and 41.8%, respectively.

The role of water in increasing the yield may be explained by its role in photosynthesis this is confirmed by the study of Hoare & Barrs (1975) on the effect of different degrees of water stress, their data presented on plant responses in the terms of changes in leaf water potential, transpiration photosynthesis, translocation and carbohydrate metabolism. They concluded that mesophyll resistance and stomatal resistance rose with increasing stress and were associated with declining photosynthesis. In conclusion these physical and biochemical activities will reflect on the relative growth rate and fruiting which are main growth aspects.

Table (9) presents the results obtained for the dry weight yield in fruits of different treatments under investigation.

It is noticed from the data of (1981) that plant grown under drought water stress (E) significantly produced the least yield as 8.3 gms compared to 38.2 and 23.5 gms from treatments (A) and (D), respectively. Treatments (B), (C) and (E) nearly gave similar dry weights of fruits which were significantly lower than those obtained from (A) and (D) treatments. It is obvious from data of 1982 that the same trend of results was true and (F) treatment gave the least crop. However, both (A) and (D) treatments gave lower crop in this season and (B) treatments showed gave the highest yield. The difference in this respect was statistically significant.

Sammerizing these results water stresses as drought or logging may affect fruit set and, or increase fruit drop, speeding maturity and senescence. Consequently such cases will result in both lower number and dry weight of fruits. The dry weight percentages of fruits in both seasons ranged, between 11 % and 23 %, the least percentage was recorded in 1981 from plants receiving frequent irrigation as (A) treatment. This is logic became such succulent fruits correlated with higher content of water due to frequent irrigation.

Data in Table (8) show that PBA applied at the rate of 100 ppm, generally increased the fresh weight of fruits/

plant of C. annuum. Increasing effects on the yield are very obvious with water regime B whereas the increases were 85.2% and 68.7% respectively in 1981 and 1982. Also, with treatment D the increases was 29% in 1981 and 73.2 % in 1982. Also, a slight increase can be noticed with the treatment F. On the other side, different response is noticed with treatment A, C and E when the same concentration 100 ppm of PBA was applied. With treatment A the decrease percentage was 16.9 % as compared to the untreated plants. The same trend was noticed in the data of 1982 as shown in Table (1982).

Raising the concentration of the applied PBA to 200 ppm, seriously decreased the fresh weight of fruits by 43.5 %, 76.1 % and 60.2 % under water regimes A, B and D, respectively in 1981 as compared with the yield of 100 ppm treated plants. However, data of 1982 showed remarkable increases in the yield of A, B and D treatments. The increasing percentages in order were 17.2 %, 28.7 % and 92.9 % as compared with the untreated plants grown under the same water status.

Also, the same concentration 200 ppm raised the yield of fruits of treatments C, E and F by 49.3 %, 71.0 and 119 % respectively as compared to the plants treated with

100 ppm PBA concentration. This was true also in the first two cases in 1982. Accordingly, if plants are grown under water stress of drought conditions, the application of PBA at the high concentration 200 ppm is suitable for increasing the crop.

Also, PBA can be advised to be applied at both used concentrations the for increasing crop when pepper is grown under water regime as D (irrigation every 15 days to attain 100 % F.C.). In this order, PBA may take place in the organization of the stomata action and transpiration aspects.

No need to apply this growth regulator when plants are grown under conditions similar to that of A water regime, decreasing effects may happen Table (8). Many inves= tigators showed that PBA had influenced the yield of some different plants among them. Bryan (1979), found that spraying tomatoes, cvs. Walter and Florida, with cytex (a natural cytokinin source) increased average yields by 2.8t/acre, compared with unsprayed controls.

Jeffcoat (1977) found that the application of PBA to flower buds at an early stage of development increased the fresh weight of carnation flowers or chrysanthemum inflorescences.

Data in Table (8) of 1981 and 1982 seasons indicate that applications of NPA at both proposed concentrations as 100 and 200 ppm obviously decreased the fresh weights of produced fruits as compared to untreated plants grown under the different water regimes.

Hence, NPA may not be advised for applications at the proposed concentrations on pepper.

As for the effect of PBA on the dry weight of fruits of C. annuum,data in Table (9) show that the concentration 100 ppm in most cases increased the dry weight of fruits. In (1981) this was true with treatments (A), (B), (C), (C), (E), and (F) and treatments (D) and F in (1982).

The most promising effect for PBA on increasing the dry weight was with treatment (D) in 1982 with both concentrationsas 100 ppm and 200 ppm of PBA. It means that PBA can be applied for better yield of dry weight of capsicum and can replace frequent irrigation as treatment (B).

This result is economically valuable, better crop can be attained under lower levels of watering as (D) by using the concentration 100 ppm of PBA.

The other growth regulator seriously affected the dry weight of yield in 1981 as well as most of treatments in 1982.

According NPA application is not recommended for application in the similar cases of irrigation of _C. annuum_.

1.7. Fresh weight in gms and dry weight percentage of roots :

Data in Table (10) indicate that the fresh weight of roots per plant ranged between 15.0 to 28.0 (gms.) in (1981) and from 5.7 to 10.5 gms. in (1982). The differences in the means of the two seasons were due to seed variability rather than experimental influences. In (1981) the best treatment of irrigation which gave the heaviest weight of fresh weight was (A) and in (1982) it was treatment (B).

Regarding the effect of PBA on the fresh weight of roots obvious from the data in Table (10) that both concentrations as 100 and 200 ppm had considerable and significant effect on increasing the fresh weight of roots in (1981), with treatments (A), (B), (C) and (F) the increases over control were 25 %, 58 %, 80 % and 81 %, respectively, when 100 ppm PBA was applied. For the 200 ppm with the same treatments, the increases in order were 42 %, 129 %, 76 % and 80 % respectively. The same trend was obvious with treatment (D) in (1982).

With most of water regime treatments in (1982) NPA gave stimulating effects on the growth of roots expressed as their fresh weight. These results show that both cytokinens had great effect on the fresh weight of roots.these, Table (10) : Effect of water regime and different concentrations of (PBA) and (NPA) on the fresh **weight of roots/plant in gms of _Capsicum annuum_ L.**

	Season 1982				
GR.*		PBA		NPA	
Irr.*** / Conc.**	0.0	100	200	100	200
A	6.7	6.4	8.5	9.3	11.9
B	10.5	15.2	8.5	12.2	12.4
C	5.7	6.6	5.6	6.7	7.4
D	9.3	18.4	19.6	12.3	14.8
E	9.8	9.3	6.8	8.5	9.1
F	7.4	7.2	6.7	10.0	11.2

L.S.D.		Irr.	GR.	Conc.	GR.Irr.	Irr.xConc.	GR.xConc.	GR.xIrr.xConc
1982	5 %	1.30	N.S	N.S	N.S	N.S	N.S	N.S
	1 %	1.83	N.S	N.S	N.S	N.S	N.S	N.S

* Growth regulator

** Concentration.

*** Irrigation.

Table (11) : Effect of water regime and different concentrations of (PBA) and (NPA) on the dry weight percentage of roots of <u>Capsicum</u> <u>annuum</u> L.

	Season (1982)				
GR.*		PBA		NPA	
Conc.** / Irr.***	0.0	100	200	100	200
A	28.6	31.9	30.1	34.0	21.9
B	30.2	28.1	28.0	30.1	34.0
C	26.7	31.8	34.5	29.4	30.2
D	30.1	33.4	33.6	40.6	27.4
E	39.8	41.6	40.9	34.5	36.3
F	44.9	34.9	36.3	36.1	26.2

* Growth regulator
** Concentration
*** Irrigation.

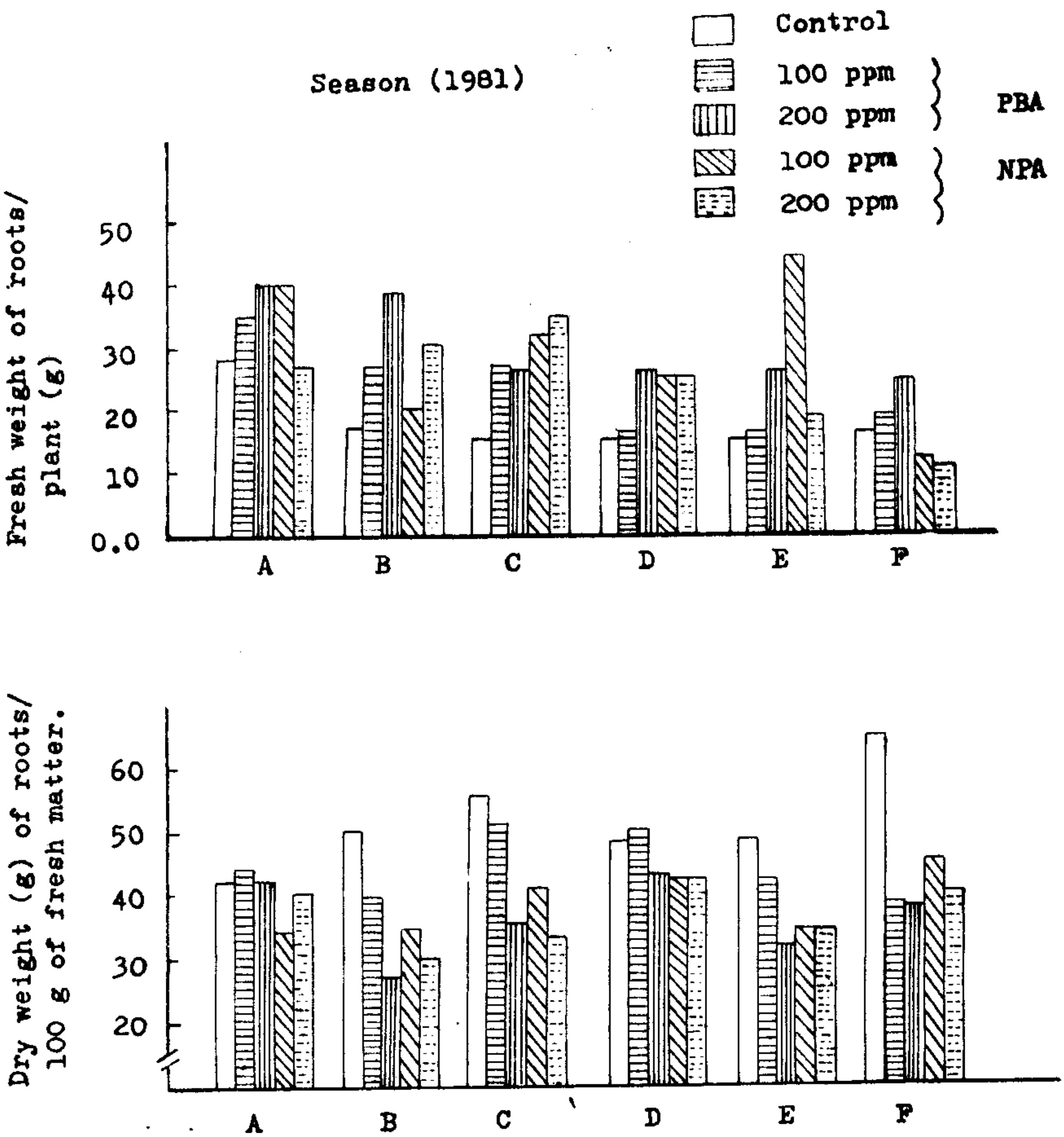

Fig. (2) : The effect of water (A,B,C,D,E and F) treatments.

These results hold true with those reported by Saraswathamma (1979). He found that the foliar applied of kinetin (25 or 250 ppm) to 20 day-old plants of Atriplex hortensis, enhanced root growth.

Data in Table (11) reveal that the dry weight percentage of roots of pepper in both seasons was increased as the water supply decreased. In (1981), the dry weight % of the water stress treatment (F) was 64.7 % compared to 42.1 % for (A) treatment which represent the frequent irrigation.

The same trend was true in 1982. This could be explained by increasing and accumulation of many substances in roots of plants subjected to drought in some way to adopt the plant and roots for the absorbtion of water.

Concerning the effects of both growth regulators, data in Table (11) show that cytokinins decreased the accumulation of substances in roots. Hence, a decreasing effects on the dry matter percentages in roots was obvious with both growth regulator, both concentrations in (1981), but in (1982) these was true with plants grown under drought condition as (F).

In conclusion, water supply as irrigation every 15 days to attain 100 % F.C. with water amount as (4300 M^3/feddan coineided.

With 100 and 200 ppm of PBA and NPA was found to be the best treatment for increasing the vegetation and roots growth of pepper. From an economical point of view, treatment (D) gave best vegetation and roots growth and it can be advised for the production of better crop of pepper.

Growing pepper under water stress as treatment (A) irrigation every 5 days to attain 100 %. F.C. which need an amount of water as 6472 M^3/feddan and which may cause bad aeration for roots has to be avoided.

If necessary due to shortage of water supply in same areas pepper plants have to be treated with 100 ppm of PBA to correct the physiological disturbance, since, results showed that this growth regulator was effective in increasing vegetative growth.

Also, it could be mentioned that growth regulators as cytokinins have effects on enzyme activity involved in the hydrolysis of proteins, RNA and carbohydrates.

Such results and conclusions are in agreement with those reported by Kharanyan (1972). He found that CCC prevents protein degradation in the leaves during time of dryness.

Ong (1978) found that endogenous cytokinin activities in the cotyledons were reduced by water stress while application of kinetin reversed water stress effects on the enzymes.

II. Effect of Water Regime and Different Concentrations of (PBA) and (NPA) on Chemical Composition in Capsicum annuum L. :

1. Capsaicin content :

Data in Table (12) indicate that, capsaicin, determined as mg/100 gm of dry weight of fruits of *C. annuum*, ranged between 300 - 735 mg as affected by irrigation treatments in 1981. The highest value was recorded from treatment E which represents the minimum supply of water quantity. Treatment (F) of the longest interval of irrigation gave high content of capsaicin as 648 mg/100 gm in 1981 and the highest level in 1982 as 990 mg/100 gm. It seems that shortage of water supply by mimimizing water supply or by lengthening interval of irrigation reflects on increasing capsaicin level in fruits of pepper. No obvious trend can be noticed with the other treatments when the results of both 1981 and 1982 seasons are compared in Table (12).

Some investigators as Thirumalachar (1967) recorded that the capsaicin content varied from 0.2723 to 1.1267 mg per 100 mg., and this variation is attributed to genotypic differences. Gorde (1969) found that the capsaicin content ranged from 2.40 - 4.38 mg/100 g in red fruit of

Table (12) : Effect of water regime and different concentrations of (PBA) and (NPA) on the content of "Capsaicin" in dry fruit of <u>Capsicum annuum</u> L. (mg/100 g).

	Season 1981					Season 1982				
GR.*	PBA			NPA		PBA			NPA	
Irr.*** / Conc.**	0.0	100	200	100	200	0.0	100	200	100	200
A	325.0	450.0	450.0	600.0	640.0	495.0	694.0	660.0	390.0	630.0
B	600.0	920.0	500.0	330.0	480.0	100.0	155.0	275.0	735.0	280.0
C	300.0	480.0	115.0	290.0	225.0	640.0	990.0	380.0	175.0	460.0
D	650.0	550.0	540.0	95.0	80.0	115.0	633.0	720.0	865.0	570.0
E	735.0	410.0	470.0	245.0	360.0	300.0	370.0	125.0	795.0	75.0
F	648.0	570.0	425.0	680.0	490.0	990.0	390.0	175.0	250.0	785.0
Mean	543.0	563.0	416.0	373.0	382.0	440.0	538.0	389.0	535.0	466.0

* Growth regulator
** Concentration
*** Irrigation.

capsicum. Arya and Saimi (1977) reported that the Capsaicin content of 30 chilli cvs. ranged from 0.005 to 0.089 %. Also Gsedo and Kopp (1964) found that the highest capsaicin yield was from C. annuum var. typicum fasciculatum which ranged about 640 - 768 mg /100 g.

Others indicated that water influences the content of capsaicin. Qualiotti (1971) found that Capsicum annuum which received an amount of water irrigation (as 1L/container) gave higher fruit content of capsaicin.

In (1981) and (1982), PBA at the concentration of 100 ppm increased the capsaicin content as noticed from the general means in Table (12). In (1981) the most increases were coincided in with treatment A, B and C in both seasons, the increases ranged between 50 - 60 % over their controls. With the longest interval of irrigation (F), PBA in both seasons and concentrations decreased capsaicin content. The higher the concentration applied, the lower the capsaicin content was the decrease with the high concentration in 1982 reached 82 % as compared with its control. For this reason such high concentration must not be applied when high content in pepper fruits grown under similar intervals of irrigation is aimed. PBA sprayed on plants grown under water regime (D) moderate water supply and interval showed high increase in capsaicin content in 1982 with both concentrations (Table 12).

Hence, it may be concluded that PBA may be applied to increase capsaicin content in fruits of plants grown under high or moderate water regimes.

Concerning the effects of NPA on capsaicin content, it can be noticed, from data in Table (12) in both seasons, that growth regulator at 200 ppm increased capsaicin with plants of treatment(A). This may be advisoble that such material can be applied on plants subjected to frequent irrigation if capsaicin extraction is aimed. With all other treatments on particular trend can be observed.

2. Total carbohydrates content :

A- Leaves :

Data in Table (13) show that the percentages of carbohydrates in leaves of *C. annuum* ranged between 16.2 and 33.1 %. The least percentage resulted from plots irrigated at long intervals (20 days). While (D) treatment representing moderate amount of water supply at 15-day interval gave the highest, one. Frequent

Table (13) : Effect of water regime and different concentrations of (PBA) and (NPA) on the total carbohydrates percentage in dry matter of leaves, stems and fruits of *Capsicum annuum* L.

	Season 1982														
	Leaves					Stems					Fruits				
GR*		PBA		NPA			PBA		NPA			PBA		NPA	
Conc.** / Irr.***	0.0	100	200	100	200	0.0	100	200	100	200	0.0	100	200	100	200
A	21.6	27.5	18.1	19.3	26.2	25.0	26.2	21.2	23.7	30.0	26.2	20.6	24.4	16.2	18.7
B	30.6	25.0	26.1	20.6	21.2	23.7	21.2	25.0	23.7	21.2	11.9	30.6	33.7	11.9	6.8
C	30.0	35.0	26.0	35.0	21.2	16.9	15.2	14.4	15.0	17.5	21.2	21.2	25.0	23.7	26.9
D	33.1	40.0	35.0	33.4	23.7	20.6	26.5	31.9	26.0	25.0	23.7	11.9	8.7	21.2	8.7
E	24.0	27.8	25.0	20.6	27.8	17.5	30.6	32.5	41.2	38.7	19.4	11.2	26.7	33.7	30.6
F	16.2	11.2	20.9	17.5	28.1	19.7	10.0	15.6	16.6	22.2	13.1	10.6	10.6	29.4	11.9

* Growth regulators
** Concentration
*** Irrigation.

irrigation with the highest amount of water at 5-day interval decreased the carbohydrate percentage.

Concerning the effect of PBA at 100 ppm, it seemed that growth regulator seemed to improve carbohydrate accumulation especially with treatments subjected to moderate and dificit water regimes as C, D and E treatments.

The same concentration of NPA gave similar trend with treatments C and D. While 200 ppm was very effective with the plants of F treatment.

B. Stems :

Data in Table (13) show that carbohydrate % in stems increased when plants received more quantities of water as in treatments (A) and (B) which respectively produced 25.0 and 23.7 %. The quantity of water irrigation/feddan as 3300 M^3 in (C) treatment decreased carbohydrate to 16.9 %. The same trend of result is true with (E) treatment 2150 M^3/feddan which gave 17.5 % as compared to (D) and (F) 4300, 3700 M^3/feddan giving 20.6 % and 19.7 % carbohydrates respectively. Also, longer intervals coincided with depletion of water quantity (treatment A to F) comparably decreased the carbohydrate percentages in *C. annuum* stems. These results agree with the findings of Kartalov and Dimitov, 1970, Quagleoitti (1971) and Ivanic *et al.* (1977).

Apart from the above differences, growth regulators PBA and NPA seemed to increase carbohydrate accumulation in stems of plants grown under moderate irrigation regimes as treatments D and E. In this concern the two concentrations of each growth regulator increased carbohydrate percentage.

With the other treatments, no obvious trend is observed. It may be concluded that spraying PBA and NPA at the proposed concentrations would benefit plants through the effect of cytokinins on cell enlargement and tissue differentiation etc...

Same evidences in this respect were reported by Carpenter and Roodriguez (1971).

C. Fruits:

Data in Table (13) indicate that the differences in water regime treatments did not show particular trend in carbohydrate percentages which ranged between 11.9 to 28.2% both minimum and maxcimum percentages were recorded from treatments A and B which received quantities as 4470 and 6610 M^3/feddan.

Concerning the effect of growth regulators, the most effective treatment is noticed with treatment B with which PBA raised from 11.9 to 30.6 (100 ppm) and 33.7 (200 ppm) with treatment (D) PBA atits two concentrations caused remarkable depletion in carbohydrate percentage.

Generally, PBA and NPA did not show clear response for carbohydrate percentages in fruits.

3. <u>Chlorophyll content</u> :

Table (14) shows that chlorophyll (a) in the leaves varied tremendovsly according to the water regime treatments. With (A) treatment (frequent irrigation every 5 days), the chlorophyll (a) and (b) percentages were the lowest. On contrary treatment (F) resulted in the highest percentage of both chlorophyll a and b.

Both growth regulators (PBA and NPA) at both concentrations, in most cases-reduced the chlorophyll a and b percentages. Exeption from this evidence is noticed with

Table (14) : Effect of water regime and different concentrations of PBA and NPA on the chlorophyll content (mg/100 g) of fresh leaves of *Capsicum annuum* L.

	Season (1982)									
	Chlorophyll (a)					Chlorophyll (b)				
GR.*		PBA		NPA			PBA		NPA	
Conc.** / Irr.***	0.0	100	200	100	200	0.0	100	200	100	200
A	71.6	55.2	86.1	96.5	104.0	46.7	28.5	54.9	43.0	59.1
B	149.0	157.7	114.8	112.2	84.9	66.9	71.8	57.8	53.4	36.9
C	134.3	130.8	113.5	136.3	130.8	61.5	73.1	55.6	71.6	73.1
D	121.3	150.8	109.5	104.0	104.3	69.0	79.8	67.6	59.1	56.3
E	112.5	115.8	94.3	79.3	60.2	53.4	62.9	49.2	46.6	53.6
F	156.6	150.8	125.1	102.1	127.7	83.1	79.8	62.2	62.5	66.7

* Growth regulators.
** Concentration.
*** Irrigation.

water regime (A) when the 200 ppm of GR increased the percentages of a and b chlorophyll. So, it may be concluded that cytokinens may correct the effect of water logging on chlorophyll content in pepper plants. Buschmann (1980) found that when radish seedlings were grown without or with kinetin Kinetin not only induced a higher accumulation of chlorophyll and protochlorophyllide but also changed the amount of in vivo chlorophyll forms which led to more effective photosynthetic activity.