4. RESULTS and DISCUSSION

4.1. Growth Behaviour :

4.1.1. Stem length :

Stem length of soybean plant during its growth cycle as affected by soil moisture levels and growth regulators in the two seasons is presented in Table (3). Mean of the two seasons as well as the periodic increase in stem length is recorded in Table (4). Results clearly indicate that stem length increased gradually from emergence up to the age of 100 days after sowing. After that time, stem length seemed to be constant. Such trend may show that the plant reached its maximum height at 100 days. The highest proportion of stem length was found to be during the first 100 days of its growth.

Regarding the effect of soil moisture levels on stem length, data showed that irrigation treatments have a significant effect on such character. Increasing water deficit did result in a significant decrease in stem length of soybean plant. This trend was found to be obvious in the all tested periods as well as in the two seasons. Such results may indicate the importance of soil moisture for the growth of plants. The highest stem length was scored from the wet treatments (85 % F.C.), while the shortest stems were gained from those plants grown under dry condition (55 % F.C.). However, medium soil moisture levels have intermediate values of stem length.

Water stress has a direct effect on cell turgor through two important phenomena, stomatal closure and cell enlargement. Complete

Table (3) : Effect of soil moisture levels and some growth regulators on soybean stem length (cm), throughout its growth cycle, during 1988 and 1989 seasons.

Treatments	Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)								L.S.D. at 5 %		
	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			alar (ppm)			Irrig. $\bar{X}$	Irriga-tion	Growth Sub.	Concen-tration
		100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$				
Season 1988																											
[illegible] days	35.3	57.3	88.0	60.2	47.0	30.7	37.7	48.9	34.3	49.3	84.0	55.9	30.3	30.3	31.7	43.8	31.0	48.7	53.3	44.3	29.3	29.3	29.9	37.1	2.3	1.9	2.3
5 days	89.7	98.0	96.3	94.7	94.0	92.0	91.9	93.3	80.7	96.0	95.0	90.6	81.0	81.7	81.1	85.8	71.7	80.7	83.7	78.7	74.3	73.0	73.0	75.8	2.7	2.2	2.7
00 days	95.7	102.3	100.0	99.3	96.0	94.0	95.2	97.3	83.3	101.3	99.0	94.6	88.3	88.0	86.6	90.6	72.3	90.3	86.7	83.1	78.0	77.7	76.0	79.6	3.6	3.3	3.6
130 days	97.0	104.3	100.7	100.7	103.0	101.3	100.4	100.6	84.0	102.3	99.7	95.3	90.0	89.3	87.8	91.6	73.3	91.0	88.0	84.1	79.0	78.7	77.0	80.6	3.1	2.5	3.1
Season 1989																											
50 days	36.7	62.0	62.7	53.8	34.0	32.7	34.4	44.1	35.0	61.0	61.7	52.6	34.0	31.7	33.6	43.1	29.3	53.3	55.3	46.0	33.0	30.3	30.9	38.4	3.0	2.4	3.0
75 days	63.7	79.7	98.0	80.4	73.0	70.0	68.9	74.7	61.0	78.0	85.0	74.7	68.0	61.0	63.3	69.0	52.3	63.0	81.0	65.4	66.0	60.7	59.7	62.6	3.5	2.9	3.5
100 days	71.7	81.0	100.7	84.4	80.0	76.0	75.9	80.2	71.3	80.3	86.0	79.2	75.0	66.0	70.8	75.0	58.3	72.7	83.0	71.3	74.3	64.0	65.6	68.4	3.8	3.1	3.8
130 days	74.3	84.0	101.0	86.4	81.0	80.7	78.7	82.6	71.3	81.3	86.0	79.6	76.7	66.3	71.4	75.5	66.0	73.3	83.0	74.1	75.3	65.0	68.8	71.4	4.1	3.4	4.1

Table (4) : Effect of soil moisture levels and some growth regulators on soybean stem length (cm), throughout its growth cycle. (mean of two seasons and periodic increase).

Treatments	Wet (85 % F.C.)								Medium (70 % F.C.)							
	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$
		100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$	
Mean of two seasons																
50 days	36.0	59.7	75.4	57.0	40.5	31.7	36.1	46.6	34.7	55.2	72.9	54.3	32.2	31.0	32.6	43.5
75 days	76.7	88.9	97.2	87.6	83.5	81.0	80.4	84.0	70.9	87.0	90.0	82.6	74.5	71.5	72.3	77.5
100 days	83.7	91.7	100.4	91.9	88.0	85.0	85.6	88.8	77.3	90.8	92.5	86.9	81.7	77.0	78.7	82.8
130 days	85.7	94.2	100.9	93.6	92.0	91.0	89.6	91.6	77.7	91.8	92.9	87.5	83.4	77.8	79.6	83.6
Periodic increase																
50 days	42.0	63.4	74.7	60.9	44.0	34.8	40.3	50.9	44.7	60.1	78.5	62.1	38.7	39.8	41.0	52.0
75 days	47.5	31.0	21.6	32.7	46.7	54.2	49.4	40.8	46.6	34.6	18.4	32.3	50.7	52.1	49.9	40.7
100 days	8.2	3.0	3.2	4.6	4.9	4.4	5.8	5.2	8.2	4.1	2.7	4.9	8.6	7.1	8.0	6.3
[illegible] days	2.3	2.6	0.5	1.8	4.4	6.6	4.5	3.1	0.5	1.2	0.4	0.7	2.0	1.0	1.1	1.0

Treatments	Dry (55 % F.C.)								L.S.D. at 5 %		
	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Irrigation	Growth Sub.	Concentration
		100	200	$\bar{X}$	1000	2000	$\bar{X}$				
Mean of two seasons											
50 days	30.2	51.0	54.3	45.2	31.2	29.8	30.4	37.8	2.2	1.8	2.2
75 days	62.0	71.9	82.4	72.1	70.2	66.9	66.4	69.3	1.9	1.5	1.9
100 days	65.3	81.5	84.9	77.2	76.3	70.9	70.8	74.0	1.8	1.4	1.8
130 days	69.3	82.2	85.5	79.1	77.2	71.9	72.9	76.0	1.8	1.5	1.8
Periodic increase											
50 days	43.3	62.0	63.5	57.2	40.4	41.4	41.7	49.7	-	-	-
75 days	45.7	25.4	32.9	34.0	50.5	51.6	49.4	41.4	-	-	-
100 days	4.7	11.7	2.9	6.4	7.8	5.6	6.0	6.2	-	-	-
[illegible] days	6.3	0.9	0.7	2.4	1.3	1.4	2.9	2.7	-	-	-

or almost complete closure of stomata can therefore markedly reduce both processes and ultimately reduces plant growth. In this respect, Kramer (1977) mentioned that maximum level of turgor is essential for cell enlargement.

Concerning the effect of growth substances on stem length of soybean, results of Tables (3, 4) proved that both growth regulators i;e. GA_3 or Alar had a significant effect on stem length. The use of GA_3 increased stem length significantly over the other treatments. Such findings can be ascribed to the stimulative effect of GA_3 on the growth of plants which was reflected on the stem length. The stimulative effect of GA_3 was reported by Jackson and Edela (1962), who attributed the increase in stem length of GA_3 treated plants to enhancing cell elongation or cell division and consequently internode length.

Also, Bensen et al. (1990) reported that Gibberellic acid plays a role in adjusting hypocotyl elongation rate. The changes observed are not of sufficient magnitude to suggest that they are the primary regulators of elongation rate.

The application of Alar (a growth retardant) resulted in a reverse trend to that observed with GA_3. In other words, the use of Alar reduced stem length of soybean plant. Such retarding effect was enhanced by increasing the rate of application i.e. 2000 ppm. This pattern can be ascribed to the retarding effect of such chemical on the growth of plants thereby, stem length. These results are in agreement with those reported by Karczmarczyk et al. (1980) who pointed out that Alar inhibits shoot and root growth of soybean plant at all concentrations but particularly at 1000 ppm. The higher concentration of Alar also inhibits seedling growth.

With regard to the interaction between different treatments i.e. soil moisture levels, growth substances and their concentrations, results clearly indicate that the promoting or retarding effect of such chemicals seemed to be higher by increasing the application rate. Such effect was found to be significant. It is worthy to mention that the stimulative effect of GA_3 was influenced by the level of soil moisture. In other words, decreasing soil moisture level (increasing water deficit), did result in reducing the enhancing effect of GA_3. This phenomena can be detected from the values of stem length under medium or dry irrigation treatments. Such findings may prove the importance of soil water for such chemical to express the enhancing effect on plant growth thereby on stem length. In this connection, Vaadia et al. (1961), Gates (1964) and Salter and Goode (1967) pointed out that cell division appears less senstive to water dificit than cell enlargement. Pitenov (1965) and Brouwer (1963) concluded that cell number is frequently of the same order in plants improved to water deficit when compared to those grown under wet conditions, however, cell size is greater in the later. The previous results are in full agreement with those reported by Nowakowski and Lubanska (1975) who pointed out that IAA and GA_3 increased the photo synthetic intensity of plants under high soil moisture level while had no effect under dry conditions.

The retarding effect of Alar seemed to be related to the level of soil water. Such effect was found to less under severe water stress. This trend can be explained on the basis that the effect of water deficit is more than any other hormonal influence. Alar is considered as anti-GA i.e. affects cell division or/and cell elongation, but soil water is important for the expression of retarding effect of such chemical.

In the light of the previous results, it can be concluded that soil moisture level proves to be one of the cheif constrains on soybean growth, thereby stem length. Growth promoter (like GA_3) stimulated stem length of soybean plant. Such stimulative effect needs soil water to be mentioned at a high level. However, Alar (a growth retardant) inhibits the growth of soybean plant which was reflected on stem length.

4.1.2. Leaf area/plant :

Total leaves area/plant of soybean under the different treatments i.e. soil moisture levels, growth regulators and their concentrations throughout its growth cycle in the two seasons is presented in Table (5). Mean values of the two seasons as well as periodic increase is recorded in Table (5).

Available data of Table (5) showed that values of leaf area/plant started with lower values early in the season (50 days after sowing) and increased gradually to reach a maximum when plant aged 100 days. This pattern is mainly due to the increase in plant vegetation. Leaf area/plant is connected with two factors: a) number of leaves/plant or the formation of new leaves and b) the expansion of leaves or the degree of leaf expansion. Thus any factor affects either the

Table (5) : Effect of soil moisture levels and some growth regulators on soybean leaf area/plant (cm^2) throughout its growth cycle.

Treatments	Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)								L.S.D. at 5 %		
	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Irrigation	Growth Sub.	Concentration
		100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$				
Season 1988																											
50 days	1247	1414	1503	1388	1254	967	1156	1272	709	846	960	838	792	741	747	793	561	788	764	704	789	741	697	701	26	21	26
75 days	1351	2106	2347	1935	1904	1537	1597	1766	889	1979	1364	1411	1103	1348	1113	1262	776	996	1136	969	1029	929	911	940	36	30	37
100 days	1875	2312	2413	2200	1614	1361	1617	1908	1379	1589	1604	1524	1076	1001	1152	1338	924	1028	1190	1049	1013	816	918	983	43	35	N.S.
Season 1989																											
50 days	867	989	1040	965	900	868	878	922	798	948	1029	925	857	796	817	871	602	760	941	768	711	701	671	720	22	18	22
75 days	2091	2330	3252	2558	2123	1936	2050	2304	1865	2240	2810	2305	2005	1830	1900	2103	769	895	1728	1131	877	853	833	982	47	39	47
100 days	2399	2531	3693	2874	1827	1802	2009	2442	2100	2324	3007	2477	1963	1731	1931	2204	907	1236	1822	1322	802	796	835	1078	54	44	54
Mean of two seasons																											
50 days	1057	1202	1272	1177	1077	918	1017	1097	754	897	995	882	825	769	783	833	582	794	853	736	750	721	684	710	13.0	N.S.	N.S.
75 days	1721	2218	2800	2246	2014	1737	1824	2035	1377	2110	2087	1858	1554	1589	1507	1683	773	946	1432	1050	953	891	872	961	28.0	23.0	28.2
100 days	2137	2422	3053	2537	1721	1582	1813	2175	1740	1957	2306	2001	1520	1366	1542	1772	916	1132	1506	1185	908	806	877	1031	27.0	22.0	N.S.
Periodic increase or decrease																											
50 days	50	50	42	46	54	53	56	50	43	43	43	44	53	48	51	47	64	68	57	62	79	81	78	69	-	-	-
75 days	31	42	50	42	46	47	44	43	36	57	47	49	47	52	47	48	21	15	38	26	21	19	21	24	-	-	-
100 days	19	8	8	12	-15	-9	-1	7	21	-7	10	2	-2	-14	2	5	15	17	5	12	-5	-10	1	7	-	-	-

formation of leaves and/or its expansion, has a great influence on leaf area/plant. The above two factors may explain the increase in leaf area/plant from emergence up to 100 days after sowing. In this connection, Black (1963) concluded that leaf area rises to a maximum and then falls thereafter.Also, Sherif (1983) and Abbas (1988) pointed out that leaf area of soybean plant goes parallel to the increase in the vegetative growth of the plants. Sherif (1983) added that a decline in leaf area values occurred when plants aged 90 days from sowing.

Regarding the role of soil moisture levels on leaf area/plant, results Table (5) clearly indicate that soil water has a significant effect on such character. The wet treatment (irrigated at 85 % field capacity) gave the maximum values of leaf area/plant followed by medium soil moisture level. However, the dry irrigation treatment (55 % F.C.) produced the lowest values of leaves area/plant. These results may prove that prolonged irrigation intervals (dry treatments) did result in a significant reduction in total values of leaf area/plant. Such plants seemed to be grown under dry conditions and suffer from water deficit. In other words, maintaining soil moisture at higher level by frequent irrigations is important for higher values of leaves area/plant. These results are mainly due to the principle effects of water deficit on the reduction in turgor of cells. Reduction in turgor caused reduction in cell enlargement, which in turn decreases leaf enlargement.

In this connection; Wadleigh and Gauch (1948) demonstrated a close relationship between decreasing turgor and decreasing enlargement of plant organs. Boyer (1968) reported that sunflower leaf enlargement ceased when leaf water potential fell below 3.8 bars and the turgor pressure below 6.8 bars. Also, Kramer (1969) concluded that plants subjected to water stress not only show a general reduction in size but also exhibit characteristic modifications in structure, particularly of the leaves. Leaf area, and all size are usually decreased. Similar results for the effect of water stress on soybean leaf area were reported by Adjei-Twun and Splittstoesser (1976), Sivakumar et al. (1977), El-Wakil (1979), Sherif (1983) and Abbas (1988).

Concerning the role of growth regulators i.e. GA_3 or Alar on leaves area/plant, results showed that such substances induced a significant effect on the values of leaves area/plant. This significant response was found to be true during the different periods of soybean growth i.e. 50, 75 and 100 days after sowing. GA_3 application resulted in a significant increase in total leaf area/plant throughout the growth cycle of soybean. Such increase in leaves area/plant was found to be significant over the control treatment or those sprayed with Alar. These findings can be attributed to the stimulative effect of GA_3 on leaf expansion. The stimulative effect of GA_3 seemed to be related to the concentration used. As GA_3 concentration increased, leaves area/plant increased. This trend was found to be clear from results presented in Table (5). When GA_3 rate increased from 100 ppm to 200 ppm, the values of leaves area/plant increased. Such increase was found to be significant. The stimulative effect of GA_3 on the growth of soybean plant has been mentioned previously on stem length. These findings mean that any factor affecting the stem length of soybean may have a role on the expansion of leaves thereby total leaves area/plant. Many workers suggested that GA_3 affectes the growth of plants through either cell division and/or cell elongation (Jakson and Edela 1962).

Results of Alar showed a reverse trend to that observed with GA_3. In other words, the use of Alar caused a depressive effect on total leaves area/plant compared with the corresponding values of control treatment. Such depressive effect followed Alar application seemed to be increased by increasing the rate from 1000 to 2000 ppm. This trend may prove that growth retardants like Alar caused a reduction in the growth of the treated plants. Many workers showed that growth retardents may influence the biosyntheses of gibberellic acid (Livne and Vaadia, 1965). Such substances retard physiological processes thereby total leaves area reduction may be related partially, to the reduction in number of leaves as well as to less expansion of leaves of those plants treated with retardants.

In this respect, Anton (1991) showed that Alar application had a depressive effect on the values of leaves area/plant for those plants treated with Alar. He also added that such decrease was increased by increasing the rate of application.

Concerning the effect of soil moisture levels on the behaviour of growth regulators, results of Table (5), showed that the role of growth substances on leaves area/plant was more related to water dificit. The enhancing effect of GA_3 was found to be clear under wet condition. This means that soil moisture stress may reduce the stimulative effect of GA_3 on leaf expansion. Such pattern can be detected from the values of leaves area/plant under the different soil moisture levels. In this connection, Miseha (1983) concluded that the promoting effect of GA_3 seemed to be clear under wet conditions, whereas, inhibited when plants were imposed to severe moistere stress. As for the interaction between growth retardant and water deficit, results showed that the depressive effect of such chemical was found to be greater under soil moistere stress rather than under wet conditions. These findings may prove that growth retardants act very well under water deficit more than low soil moisture stress (wet soil moisture levels). It can be mentioned that low concentration of Alar stimulated slightly the values of leaves area/plant under low soil moisture stress compared with those obtained from dry treatments. These results indicate that soil moisture levels is very important for retardants to play its role in the growth of plants.

In the view of the previous results, soil moisture levels exhibit a measurable differences in leaves area/plant. For the maximum expansion of leaves, soil water must be maintained at a high level. Also, growth promoting substances stimulated the growth of plants which was reflected lected on their total leaves area/plant. This pattern can be acheived by growing plants under wet conditions and when water deficit was increased, the enhancing effect of GA_3 is reduced, growth retardants had a depressive effect on plant growth thereby leaf expansion. Such retarding effect can be increased either by high rate of growth retardants or by water deficit. Thus, it can be concluded that there is a complete correlation between the regulating effect of growth substances and soil moisture levels. Such regulatory effect either stimulation or retardation was controlled by the soil moisture level.

In this respect, Kramer (1969) concluded that reduced synthesis of growth regulators such as cytokinins and gubberellins in the roots is an important factor in the reduction of growth observed in plants subjected to water stress.

4.1.3. Dry matter accumulation :

Dry matter content of different plant organs throughout its growth cycle can be considered as an indirect indication for the accumulation of minerals and physiological activites of the various tested parts. In addition, it is one of the main excellent expression for plant growth behaviour. Dry matter accumulation in different soybean plant organs and periodic increase as well as percentage distribution of such values with respect to the whole plant as affected by soil moisture levels and growth regulators throughout its growth cycle is recorded in Tables (6, 7, 8, 9, 10, 11 & 12).

4.1.3.1. Dry matter of roots :

Root dry matter accumulation started with low values at earlier periods. A continous increase in dry matter content of root was observed till the last sampling date (100 days after sowing). This trend is quite clear in both seasons of study. The highest rate of dry matter accumulation of roots falls in the period extended from 50 up to 75 days after sowing. However, at later periods the rate was found to be less than any other period of soybean growth. Such findings can be ascribed to that most of reserved food is translocated to ble (6) : Effect of soil moisture levels and some growth regulators on root dry matter content (g./plant) at different periods of soybean growth.

eatments	Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)								L.S.D. at 5 %		
	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Irriga-tion	Growth Sub.	Concen-tration
s after ing		100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$				
Season 1988																											
0 days	1.2	2.0	1.4	1.5	1.2	1.3	1.3	1.4	1.2	1.1	1.0	1.1	1.3	1.3	1.3	1.2	0.9	1.0	1.2	1.1	1.2	0.7	1.0	1.0	0.2	N.S.	0.2
75 days	2.9	5.1	4.1	4.0	3.0	3.4	3.1	3.6	1.5	2.2	2.3	2.0	1.8	1.9	1.7	1.9	1.1	2.1	2.0	1.7	2.3	1.2	1.5	1.6	0.2	0.2	0.2
00 days	4.1	5.5	4.9	4.8	3.8	3.8	3.9	4.4	2.3	3.0	2.6	2.6	3.1	2.2	2.6	2.6	1.3	2.3	2.2	1.9	3.5	1.9	2.2	2.1	0.4	N.S.	0.4
Season 1989																											
50 days	1.4	1.7	1.5	1.5	1.4	1.3	1.4	1.4	1.3	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.0	1.4	1.2	1.2	1.1	1.2	1.1	1.1	0.1	0.1	0.1
75 days	2.9	4.6	3.5	3.7	4.2	3.2	3.4	3.6	2.6	3.2	2.8	2.9	3.0	2.3	2.6	2.8	2.0	2.9	2.5	2.5	2.8	2.3	2.4	2.5	0.2	0.2	0.2
00 days	4.0	5.3	4.3	4.5	4.8	4.2	4.3	4.4	3.6	4.3	3.0	3.6	4.0	3.7	3.8	3.7	2.2	3.3	4.3	3.0	3.0	2.5	2.6	2.8	0.2	N.S.	0.2
Mean of two seasons																											
50 days	1.3	1.9	1.5	1.6	1.4	1.3	1.3	1.5	1.3	1.3	1.2	1.3	1.3	1.3	1.3	1.3	1.0	1.2	1.2	1.1	1.2	1.0	1.1	1.1	0.1	N.S.	0.1
75 days	2.9	4.9	3.8	3.9	3.6	3.3	3.3	3.6	2.1	2.7	2.6	2.5	2.4	2.1	2.2	2.4	1.6	2.5	2.3	2.1	2.6	1.8	2.0	2.5	0.1	0.1	0.1
00 days	4.1	5.4	4.6	4.7	4.3	4.0	4.1	4.4	3.0	3.7	2.8	3.2	3.6	3.0	3.2	3.2	1.8	2.8	2.8	2.5	3.3	2.2	2.4	2.5	0.2	N.S.	0.2
Periodic increase																											
0 days	31.7	35.2	32.6	34.0	32.6	32.5	31.7	34.1	43.3	35.1	42.9	40.6	36.1	43.3	40.6	40.6	55.6	42.9	42.9	44.0	36.4	45.5	45.8	44.0	-	-	-
5 days	39.0	55.6	50.0	48.9	51.2	50.0	48.8	47.7	26.7	37.8	50.0	37.5	30.6	26.7	28.1	34.4	33.3	46.4	39.3	40.0	42.4	36.4	37.5	56.0	-	-	-
0 days	29.3	9.2	17.4	17.1	16.2	17.5	19.5	18.2	30.0	27.1	7.1	21.9	33.3	30.0	31.3	25.0	11.1	10.7	17.8	16.0	21.2	18.2	16.7	00.0	-	-	-

reproductive organs. The above mentioned results are in line with those reported by Abbas (1988).

Water regime exhibits a significant effect on root dry matter throughout its growth cycle. This trend was found to be true during the different periods of soybean growth. Increasing water defecit did result in a significant decrease in dry matter of soybean root. On the other hand, maximum root dry matter was gained under wet conditions i.e. 85 % field capacity. However, intermediate values of root dry matter was observed from the medium soil moisture levels. Such findings may prove that dry matter accumulation is favoured by abundance of soil water and plant growth is inhibited under dry conditions. The previous findings may prove the importance of maintaining soil water at a high level for maximum accumulation of dry matter in roots. Such trend can be related to the multiple effects of water stress on plant growth thereby on dry matter production.

Regarding the effect of growth substances i.e. GA_3 on Alar on root dry weight results indicate that both substances had a significant response on such character during different periods of growth. In other words, GA_3 application seemed to enhance dry matter accumulation soybean plants treated with GA_3 have higher dry matter content compared with the corresponding values of the untreated plants (Control) through the different periods of growth. The most pronounced concentration was found to be 100 ppm. This concentration gave higher root dry matter production either over the control or the other GA_3 concentration. In this respect, Gosheh <u>et al.</u> (1963) concluded that the direct effect of GA_3 was its influence on increasing fresh and dry weight of plant tops. Castro (1980) and Baza (1985) concluded that increasing applied GA_3 decreased the dry weight of plant organs compared with the lower concentration.

As for Alar, results of Table (6) showed that it had a depressive efect on dry matter of soybean root throughout its growth cycle. Such reduction was found to be clear with higher concentration (2000 ppm) than the lower one i.e. 1000 ppm.

These findins can be attributed to the retarding effect of such substances on the growth of plants which was reflected on root dry matter.

The dry matter of soybean root seemed to be connected with soil moisture levels. It can be mentioned that the stimulating effect of GA_3 was found to be more under high soil moisture levels and decreased by increasing water deficit. Such pattern may prove that soil water is an important factor controlling the behaviour of growth promoting substances. The reverse pattern was found to be true with Alar (growth retardent). In other words, dry conditions induced the retarding effect of Alar. In this respect Hubick et al. (1986) concluded that the effect of drought on GA_3 and ethylene was minimal, however, abscisic acid was markedly higher in stressed plants.

4.1.3.2. Stem dry matter :

Stem dry matter production was lower early in the season when the plants are small, then increased gradually to reach its maximum

Table (7) : Effect of soil moisture levels and some growth regulators on stem dry matter content (g./plant) at different periods of soybean growth.

Treatments	Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)								L.S.D. at 5 %		
Days after sowing	Control	GA_3 (ppm) 100	GA_3 (ppm) 200	$\bar{X}$	Alar (ppm) 1000	Alar (ppm) 2000	$\bar{X}$	Irrig. $\bar{X}$	Control	GA_3 (ppm) 100	GA_3 (ppm) 200	$\bar{X}$	Alar (ppm) 1000	Alar (ppm) 2000	$\bar{X}$	Irrig. $\bar{X}$	Control	GA_3 (ppm) 100	GA_3 (ppm) 200	$\bar{X}$	Alar (ppm) 1000	Alar (ppm) 2000	$\bar{X}$	Irrig. $\bar{X}$	Irrigation	Growth Sub.	Concentration
Season 1988																											
50 days	2.7	5.5	4.4	4.2	3.3	2.5	2.8	3.8	2.5	2.6	3.3	2.8	2.9	2.4	2.6	2.7	2.1	2.0	3.3	2.5	2.3	2.0	2.2	2.3	0.3	0.3	0.3
75 days	10.2	17.1	13.1	13.5	13.1	10.9	11.4	12.5	4.9	6.8	7.1	6.3	7.7	5.1	5.9	6.1	3.4	4.1	5.0	4.2	3.9	3.7	3.7	4.0	0.6	0.5	0.6
100 days	13.8	19.2	16.8	16.6	15.4	13.5	14.2	15.4	7.3	12.0	8.4	9.2	11.0	5.6	8.0	8.6	3.6	8.9	5.3	5.9	6.3	3.9	4.6	5.3	0.8	0.6	0.8
Season 1989																											
50 days	2.9	3.6	3.7	3.4	3.3	3.0	3.1	3.2	2.7	3.1	3.4	3.1	3.2	2.8	2.9	3.0	2.3	2.5	2.3	2.3	2.4	2.2	2.3	2.3	0.1	0.1	0.1
75 days	10.7	18.8	18.6	16.0	13.5	9.5	11.2	13.6	8.2	15.8	13.2	12.4	11.8	7.0	9.0	10.7	3.5	9.4	8.2	7.0	7.7	5.1	5.4	6.2	0.4	0.4	0.4
100 days	20.4	28.9	29.7	26.3	24.0	21.6	22.0	24.2	9.8	15.2	21.1	15.4	12.4	11.3	11.2	13.3	6.0	10.2	7.9	8.0	9.6	6.8	7.5	7.8	0.7	0.6	0.6
Mean of two seasons																											
50 days	2.8	4.6	4.1	3.8	3.3	2.8	3.0	3.4	2.6	2.9	3.4	3.0	3.1	2.6	2.8	2.9	2.2	2.3	2.8	2.4	2.4	2.1	2.2	2.3	0.1	0.1	0.1
75 days	10.5	18.0	15.9	14.8	13.3	10.2	11.3	13.1	6.6	11.3	10.2	9.4	9.8	6.1	7.5	8.5	3.5	6.8	6.6	5.6	5.8	4.4	4.6	5.1	0.4	0.3	0.4
100 days	17.1	24.1	23.3	21.5	19.7	17.6	18.1	19.8	8.6	13.6	14.8	12.3	11.7	8.5	9.6	11.0	4.8	9.6	6.6	7.0	8.0	5.4	6.1	6.6	0.5	0.4	0.5
Periodic increase																											
50 days	16.4	19.1	17.6	17.7	16.8	15.9	16.6	17.2	30.2	21.3	23.0	24.4	26.5	30.6	29.2	26.4	45.8	24.0	42.4	34.3	30.0	38.9	36.1	34.8	-	-	-
75 days	45.0	55.6	50.6	51.2	50.8	42.0	45.9	49.0	46.5	61.8	45.9	52.0	57.3	41.2	49.0	50.9	27.1	46.9	57.6	45.7	42.5	42.6	39.3	42.4	-	-	-
100 days	38.6	25.3	31.8	31.3	32.4	42.1	37.5	33.8	23.3	16.9	31.1	23.6	16.2	28.2	21.8	22.7	27.1	29.1	0.0	20.0	27.5	18.5	24.6	22.8	-	-	-

at the age of 100 days. These results were found to be true in both seasons as well as the mean of them. It is worthy to mention that the grand period of dry matter accumulation in soybean stem was found to be from 50 up to 75 days after sowing. At such period about 50 % of total dry matter of stem was gained Table(7). After that period, dry matter accumulation was less compared with the former period. This period can be considered as the elongation period of stem. Also, the less dry matter accumulation observed in later stages of soybean growth is mainly related to that the plant directed its effort for the formation of pods and seed fillings.

As for the effect of soil moisture levels on stem dry mattter, results showed a similar trend to that observed with root dry weight. In other words, water deficit has a significant effect on the stem dry matter of soybean plant during the tested periods of growth. Stem dry matter showed higher values under wet conditions (high soil moisture level) and decreased as soil moisture stress increased. These results may show that growth of plants is enhanced by wet conditions and ceased as soil moisture approached wilting.

Regarding the role of growth substances on stem dry weight, data showed a trend similar to that observed with root. The use of GA_3 stimulated significantly the accumulation of dry matter in stem. Such stimulative effect was obvious under both levels of GA_3. However, the lower rate was found to be more in this respect. Also, the use of Alar seemed to enhance the accumulation of dry matter in soybean stem. On the contrary, the higher level of Alar (2000 ppm) seemed to reduce slightly dry matter accumulation in soybean stem. Such reduction may be ascribed to the retarding effect of Alar on growth. The retarding effect of Alar seemed to be enhanced under dry conditions rather than under wet soil moisture levels. The previous results indicate that the promoting effect of GA_3 seemed to be higher under wet soil moisture level, however, Alar, needs dry conditions to ensure its effect.

4.1.3.3. Leaf petiol and blade dry matter :

Leaves dry matter values were low then increased till the last sample (100 days after sowing). Such results were found to be the same in both seasons. The period from 50 up to 75 days after sowing seemed to be the greatest period of dry matter accumulation with respect to periodic increase. After such period the plant directed its effort to the formation of pods and seeds. This may explain the less relative increase in such period.

Regarding the effect of soil moisture stress on dry matter accumulation in soybean leaves, data of Tables (8, 9) showed a similar trend to that observed either with root or stem. Dry matter accumulation was enhanced by wet soil moisture levels and decreased significantly by water deficit.

Concerning the effect of growth regulators on leaves dry matter, results showed a similar pattern to that observed with root and stem. The use of GA_3 increased dry matter of leaves significantly over the control or Alar. The most pronounced concentration was 100ppm.

Table (8) : Effect of soil moisture levels and some growth regulators on leaf petiol dry matter content (g./plant) at different periods of soybean growth.

Treatments	Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)								L.S.D. at 5 %		
Days after sowing	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Irrigat-ion	Growth reg.	[illegible]
		100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$				
Season 1988																											
50 days	2.1	2.9	1.6	2.2	2.4	1.7	2.1	2.1	1.7	1.9	1.3	1.7	1.8	1.6	1.7	1.7	1.2	1.6	1.3	1.4	1.6	1.3	1.4	1.4	0.2	N.S.	0.2
75 days	4.9	8.5	6.0	6.5	7.7	6.3	6.3	6.4	2.2	4.2	3.7	3.4	4.0	3.6	3.3	3.3	2.1	4.1	2.3	2.8	3.3	2.0	2.5	2.6	0.3	N.S.	0.3
100 days	5.0	9.3	7.3	7.2	8.2	6.5	6.6	6.9	3.3	5.5	3.8	4.2	4.7	3.9	4.0	4.1	2.3	4.5	2.5	3.1	4.3	2.1	2.9	3.0	0.3	0.3	0.3
Season 1989																											
50 days	1.6	1.8	1.6	1.7	1.7	1.6	1.6	1.7	1.4	1.6	1.3	1.4	1.5	1.2	1.4	1.4	1.0	1.2	1.1	1.1	1.1	0.9	1.0	1.1	0.1	N.S.	0.1
75 days	5.7	8.3	7.1	7.0	6.2	5.4	5.8	6.4	3.9	5.0	3.2	4.0	4.2	3.1	3.7	3.9	2.5	3.0	2.8	2.8	2.7	2.0	2.4	2.6	0.3	0.3	0.3
100 days	8.4	12.7	10.1	10.4	10.2	7.4	8.7	9.5	4.5	7.0	4.0	5.2	5.1	3.9	4.5	4.8	3.2	4.4	3.9	3.8	4.0	3.0	3.4	3.6	0.3	0.2	0.3
Mean of two seasons																											
50 days	1.9	2.4	1.6	2.0	2.1	1.7	1.9	2.0	1.6	1.8	1.3	1.6	1.7	1.4	1.6	1.6	1.1	1.4	1.2	1.2	1.3	1.3	1.2	1.2	0.1	N.S.	0.1
75 days	5.3	8.4	6.6	6.8	7.0	5.9	6.1	6.5	3.1	4.6	3.5	3.7	4.1	3.4	3.5	3.6	2.3	3.6	2.6	2.8	3.0	2.0	2.4	2.6	0.2	N.S.	0.2
100 days	6.7	11.0	8.7	8.8	9.2	7.0	7.6	8.2	3.9	6.3	3.9	4.7	4.9	3.9	4.2	4.5	2.8	4.5	3.2	3.5	4.2	2.6	3.2	3.4	0.2	0.2	0.2
Periodic increase																											
50 days	28.4	21.8	18.4	22.7	22.8	24.3	25.0	24.4	41.0	28.6	33.3	34.0	34.7	35.9	38.1	35.6	39.3	31.1	37.5	34.3	31.0	50.0	37.5	35.3	-	-	-
75 days	50.7	54.5	57.5	54.5	53.3	60.0	55.3	54.9	38.5	44.4	56.4	44.7	49.0	51.3	45.2	44.4	42.9	48.9	43.8	45.7	40.5	26.9	37.5	41.2	-	-	-
100 days	20.9	23.7	24.1	22.7	23.9	15.7	19.7	20.7	20.5	27.0	10.3	21.3	16.3	12.8	16.7	20.0	17.8	20.0	18.7	20.0	28.5	23.1	25.0	23.5	-	-	-

Table (9) : Effect of soil moisture levels and some growth regulators on leaf blade dry matter content (g./plant) at different periods of soybean growth.

Treatments	Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)								L.S.D. at 5 %		
Days after sowing	Control	GA_3 (ppm) 100	GA_3 (ppm) 200	X̄	Alar (ppm) 1000	Alar (ppm) 2000	X̄	Irrig. X̄	Control	GA_3 (ppm) 100	GA_3 (ppm) 200	X̄	Alar (ppm) 1000	Alar (ppm) 2000	X̄	Irrig. X̄	Control	GA_3 (ppm) 100	GA_3 (ppm) 200	X̄	Alar (ppm) 1000	Alar (ppm) 2000	X̄	Irrig. X̄	Irrigation	Growth Sub.	Concentration
Season 1988																											
50 days	5.1	6.7	4.3	5.4	6.2	5.0	5.4	4.5	4.0	5.6	3.7	4.4	4.2	3.6	3.9	4.2	3.5	4.1	3.6	3.7	3.7	3.0	3.4	3.6	0.4	N.S.	0.4
75 days	10.1	15.4	13.8	13.1	12.1	10.0	10.7	11.9	5.3	8.5	6.3	6.7	8.2	5.7	6.4	6.6	4.6	5.0	5.2	4.9	5.0	5.0	4.9	4.9	0.5	0.4	0.5
100 days	11.2	16.4	15.2	14.3	12.3	10.9	11.5	12.9	8.5	10.8	6.4	8.6	9.5	6.6	8.2	8.4	5.0	6.2	6.0	5.7	6.5	5.8	5.8	5.8	0.6	0.5	0.6
Season 1989																											
50 days	6.0	7.5	6.7	6.7	6.4	5.6	6.0	6.4	4.2	5.1	4.9	4.7	4.8	3.6	4.2	4.5	3.4	4.1	3.7	3.7	3.9	3.0	3.4	3.6	0.2	0.2	0.2
75 days	8.5	13.1	9.0	10.2	9.3	8.0	8.6	9.4	6.0	9.0	6.5	7.2	7.8	5.7	6.5	6.8	4.8	6.0	5.5	5.4	5.3	4.6	4.9	5.2	0.4	0.4	0.4
100 days	15.1	18.2	16.0	16.4	16.6	13.0	14.9	15.7	9.2	11.2	7.3	9.2	8.3	5.7	7.7	8.5	5.2	8.1	7.0	6.8	6.8	4.9	5.6	6.2	0.4	0.3	0.4
Mean of two seasons																											
50 days	5.5	7.1	5.5	6.0	6.3	5.3	5.7	5.9	4.1	5.4	4.3	4.6	4.5	3.6	4.1	4.4	3.5	4.1	3.7	3.8	3.8	3.0	3.4	3.6	0.2	0.1	0.2
75 days	9.3	14.3	11.4	11.7	10.7	9.0	9.7	10.7	5.7	8.8	6.4	7.0	8.0	5.7	6.5	6.8	4.7	5.5	5.4	5.2	5.2	4.8	4.9	5.1	0.4	0.3	0.4
100 days	13.2	17.3	15.6	15.4	14.5	12.0	13.2	14.3	8.9	11.0	6.9	8.9	8.9	6.2	8.0	8.5	5.1	7.2	6.5	6.3	6.7	5.4	5.7	6.0	0.4	0.3	0.4
Periodic increase																											
50 days	41.7	41.0	35.3	39.0	43.4	44.2	43.2	41.3	46.1	49.1	62.3	67.4	50.6	58.1	51.3	60.0	68.6	56.9	50.9	60.3	56.7	55.6	59.6	60.0	-	-	-
75 days	28.8	41.6	37.8	37.0	30.3	30.8	30.3	33.6	18.0	30.9	30.4	11.2	39.3	33.9	30.0	20.0	23.5	19.4	26.2	22.2	20.9	33.3	26.3	25.0	-	-	-
100 days	29.5	17.4	26.9	24.0	26.3	25.0	26.5	25.1	35.9	20.0	7.3	21.4	10.1	8.0	18.7	20.0	7.9	23.5	16.9	17.5	22.4	11.1	14.1	15.0	-	-	-

However, the highest level of GA_3 seemed to decrease slightly dry matter accumulation in soybean leaves. As for Alar, data of Tables (8 and 9) indicate that the lower concentration enhanced the dry matter accumulation in leaves. However, the higher rate seemed to decrease the values of leaves dry matter. Such reduction was found to be significant either over the control or the lower rate.

As for the interaction between soil moisture levels and growth substances, data indicate that the stimulative effect of GA_3 was found to be higher under wet soil moisture level. However, water deficit seemd to inhibit such effect. On the contrary, growth retardant behaves good under dry conditions rather than wet soil moisture.

4.1.3.4. Pod dry matter :

Data of Table (10) indicate that the formation of pods started after the first sample (50 days after sowing). Pod dry matter increased till the last sampling date. This is mainly due to the formation of new pods as well as the accumulation of reserved foods in soybean seeds.

Soil moisture levels affected the dry matter content of soybean pods. Such effect was found to be significant. The values of pods dry matter/plant were higher under high soil moisture levels and decreased by increasing soil moisture stress (prolonged) irrigation intervals. Also, it can be concluded that soil moisture stress not only affects pod dry matter but also the proportion of pod productivity during different periods of growth. The early formation of pods was gained under high

Table (10) : Effect of soil moisture levels and some growth regulators on pod dry matter content (g./plant) at different periods of soybean growth.

Treatments	Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)								L.S.D. at 5 %		
Days after sowing	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Irrigation	Growth Ssub.	Concentration
		100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$				
Season 1988																											
50 days	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75 das	8.3	11.1	9.4	9.6	9.6	4.3	7.4	8.5	3.1	6.9	5.8	5.3	4.5	3.5	3.7	4.5	2.7	4.1	1.9	2.9	4.0	2.9	3.2	3.1	0.6	0.5	0.6
100 days	18.5	23.2	18.1	19.9	21.6	14.0	18.0	19.0	14.8	19.2	15.3	16.4	17.1	9.3	13.7	15.1	8.3	13.0	8.0	9.8	9.3	7.8	8.5	9.1	0.7	0.5	0.7
Season 1989																											
50 days	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75 days	9.0	12.3	10.9	10.7	9.3	4.9	7.7	9.2	2.9	7.5	4.1	4.8	5.0	3.5	3.8	4.3	1.3	2.3	1.6	1.7	1.9	1.4	1.5	1.6	0.2	0.2	0.2
100 days	14.9	22.7	20.8	19.5	17.2	13.9	15.3	17.4	9.9	20.0	17.4	15.8	14.2	8.9	11.0	13.4	7.6	9.7	8.0	8.4	8.0	7.0	7.5	8.0	0.4	0.3	0.4
Mean of two seasons																											
50 days	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75 days	8.7	11.7	10.2	10.2	9.5	4.6	7.6	8.9	3.0	7.2	5.0	5.1	4.8	3.7	3.8	4.5	2.0	3.2	1.8	2.3	3.0	2.2	2.4	2.4	0.2	0.2	0.2
100 days	16.7	23.0	19.5	19.7	19.4	14.0	16.7	18.2	12.4	19.6	16.4	16.1	15.7	9.1	12.4	14.3	8.0	11.4	8.0	9.1	8.7	7.4	8.0	8.6	0.4	0.3	0.4
Periodic increase																											
50 days	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
75 days	52.1	50.9	52.3	51.8	49.0	32.9	45.5	48.9	24.2	36.7	30.5	31.7	30.6	40.7	30.6	31.5	25.0	28.1	22.5	25.3	34.5	29.7	30.0	27.9	-	-	-
100 days	47.9	49.1	47.7	48.2	51.0	67.1	54.5	51.1	75.8	63.3	69.5	68.3	69.4	59.3	69.4	68.5	75.0	71.9	77.5	74.7	65.5	70.3	70.0	72.1	-	-	-

soil moisture level while with increasing soil moisture stress the early formation of pods declined.

The use of GA_3 seemed to stimulate the dry matter of pods/plant. Such stimulative effect was found to be more pronounced at the rate of 100 ppm. However, the higher rate of GA_3 i.e. 200 ppm seemed to be less in this respect. Soil moisture stress interacted with the promoting effect of GA_3, as this stimulative effect decreased with increasing soil moisture stress.

The application of Alar caused a retarding effect on pod dry matter production. Such retardation seemed to be enhanced by higher concentration, while the lower rate slightly increased dry matter of pods/plant. The retarding effect following Alar application seemed to be stimulated by increasing soil moisture stress and disappeared under high soil moisture level.

It can be concluded that there is an interaction between the regulating effect of the tested growth regulators and soil moisture levels, as the effect of growth substances either stimulation or retardation was controlled by the level of soil moisture.

4.1.3.5. Whole plant dry matter :

Total dry matter accumulation in whole soybean plant under the various treatments is presented in Table (11). As a general pattern, data showed a continous increase in dry matter content from emergence till the last sample. It is worthy to mention that about 50 % of total dry matter of whole soybean plant accumulated through the period from 50 up to 75 days after sowing (Table 11). However

Table (11) : Effect of soil moisture levels and some growth regulators on whole plant dry matter content (g./plant) at different periods of soybean growth.

Treatments	Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)								L.S.D. at 5 %		
Days after sowing	Control	GA$_3$ (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA$_3$ (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA$_3$ (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Irriga-tion	Growth Sub.	Concen-tration
		100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$				
Season 1988																											
50 days	11.1	17.1	11.7	13.3	13.2	10.5	11.6	12.5	9.4	11.2	9.3	10.0	10.2	8.9	9.5	9.8	7.7	8.7	9.4	8.6	8.8	7.0	7.8	8.2	0.7	0.6	0.7
75 days	36.4	57.2	46.4	46.7	45.5	34.9	38.9	42.8	17.0	28.6	25.2	23.6	26.2	19.8	21.0	22.3	13.9	19.4	16.4	16.6	18.5	14.8	15.7	16.2	1.6	1.3	1.6
100 days	52.6	73.7	62.3	62.9	61.3	48.7	54.2	58.6	36.2	50.5	36.5	41.1	45.4	27.6	36.4	38.8	20.5	34.9	24.0	26.5	29.9	21.5	24.0	25.3	1.0	0.8	1.0
Season 1989																											
50 days	11.9	14.6	13.5	13.3	12.8	11.5	12.1	12.7	9.6	11.2	10.9	10.5	10.8	8.9	9.8	10.2	7.7	9.2	8.3	8.4	8.5	7.3	7.8	8.1	1.2	1.0	1.2
75 days	36.8	57.1	49.1	47.7	42.5	31.0	36.8	42.2	23.6	40.5	29.8	31.3	31.8	21.6	25.7	28.5	14.1	23.6	20.6	19.4	20.4	15.4	16.6	18.0	0.6	0.8	0.6
100 days	62.8	87.8	80.9	77.2	72.8	60.1	65.2	71.2	37.0	57.7	52.8	49.2	44.0	33.5	38.2	43.7	24.2	35.7	30.2	30.0	31.4	24.2	26.6	28.3	1.2	1.0	1.2
Mean of two seazsons																											
50 days	11.5	16.0	12.7	13.4	13.1	11.1	11.9	12.7	9.6	11.4	14.5	11.8	10.6	8.9	9.7	10.8	7.8	9.0	8.9	8.6	8.7	7.4	8.0	8.3	0.2	0.2	0.2
75 days	36.7	57.3	47.9	47.3	44.1	33.0	37.9	42.6	20.5	34.6	27.7	27.6	29.1	20.8	23.5	25.6	14.1	21.6	18.7	18.1	19.6	15.2	16.3	17.2	0.6	0.8	0.6
100 days	57.8	80.8	71.7	70.1	67.1	54.6	59.8	65.0	36.8	54.2	44.8	45.3	44.8	30.7	43.2	44.3	22.5	35.5	27.1	28.4	30.9	22.5	25.3	26.9	0.8	0.6	0.8
Periodic increase																											
50 days	19.9	19.8	17.7	19.1	19.5	20.3	19.9	19.5	26.1	21.0	32.4	26.0	23.7	29.0	22.5	24.4	34.7	25.4	32.8	30.3	28.2	32.9	31.6	30.9	-	-	-
75 days	43.6	51.1	49.1	48.4	46.2	40.1	43.5	46.0	29.6	42.8	29.5	34.9	41.3	38.8	31.9	33.4	28.0	35.5	36.2	33.5	35.3	34.7	32.8	33.1	-	-	-
100 days	36.5	29.1	33.2	32.5	34.3	39.6	36.6	34.5	44.3	36.2	38.1	39.1	35.0	32.2	45.6	42.2	37.3	39.1	31.0	36.2	36.5	32.4	35.6	36.0	-	-	-

other periods showed less dry matter accumulation. These results indicate that the period from 50 to 75 days is considered as the grand period of dry matter accumulation in whole soybean plant.

Soil moisture levels had a significant effect on dry matter accumulation by whole soybean plant. Such significant effect was found to be clear throughout the growth cycle of the crop under study. The highest dry matter content of soybean plant was produced from the high soil moisture level followed by the medium water regime. However, the lowest values of dry matter were gained from the dry treatment (severe water deficit). These results may prove the importance of soil water for the growth of soybean plant thereby dry matter accumulation. It can be concluded that the availability of water proves to be one of cheif constrains on dry matter productivity. It is well known that total net photosynthesis is determined by the availability of light, CO_2, water and nutrients, and the growth pattern of the plant that determines both photosynthesis rate and the reinvestment rate and the response of the plant to stress. Soybean plant seemed to be grown well under wet conditions rather than either under moist or severe water deficit.

Regarding the role of growth substances on dry content of soybean plant, results of Table (11) showed that it had a significant response on dry matter accumulation. Such significant effect differs according to the role of the used regulater i.e. either promoter or retardant.

The use of GA_3 with different concentration did result in a significant increase in dry matter production by soybean plant as compared with the control. Such findings showed that growth promoting substances stimulated the accumulation of dry matter. The most effective rate was found to be 100 ppm. Such rate enhanced dry matter production either over the control or the other used level i.e. 200 ppm. In this connection, Devlin and Witham (1983) concluded that low concentration of plant hormones stimulated plant growth. Increasing the rate of applied hormone resulted in a similar increase in the stimulative effect to reach a maximum at the optimal level. However, such increase more than that level reduced the induction rate. This induction in the rate of stimulation does not mean the death of cells but the inhibition caused by hormone concentration. Thus, the response of plants to hormones may be a stimulative effect or turning on and inhibiting effect or turning off.

As for Alar treatments, results gained showed that the lower rate of Alar (1000 ppm) increased dry matter content of soybean. Such increase in dry matter was found to be significant compared with control. This trend was found to be true in the successive periods of growth. It is worthy to mention that the stimulative effect caused by low rate of Alar did not reach that caused by GA_3 at any rate. On the contrary, higher level of Alar (2000 ppm) did result in a significant reduction in dry matter accumulation, compared with the control. These findings can be attributed to the retarding effect of Alar on the growth of plants, thereby dry matter accumulation.

These results were explained by Devlin and Witham (1983) who concluded that growth retardants inhibit plant growth through their interference with the action of Gibberellin more than the inhibition of biosynthesis of GA_3.

Concerning the behaviour of growth substances under different soil moisture levels, different phenomena were observed. Growth promoter i.e. GA_3 enhanced dry matter accumulation more under wet conditions. However, such promotive effect of GA_3 was inhibited under lack of soil moisture (severe water deficit). On the contrary, growth retardants like Alar seemed to work very well under dry condtions rather than wet soil moisture levels.

4.1.3.6. Dry matter distribution :

Dry matter distribution of the different plant parts of soybean during its growth cycle under the various treatments, is illustrated in Table (12). Data showed that leaves (blades + petiols) comprise the main dry matter component through the first 50 days followed by stem, while root ranked the third in this respect. Moreover, when plants aged 75 days, stem dry weight was supperior in this respect as it seemed to have the highest proportion followed by leaf blade, pods and petiols while root was the lowest one. Later on (at 100 days) stem and pods dry weight were the domenant organs followed by leaf blade, leaf petiol and root was the lowest in this respect. From the previous results, it can be mentioned that there are a variable developmental changes in dry matter of individual plant parts and that affected the final growth changes of the entire plant. Such results

Table (12) : Effect of soil moisture levels and some growth regulators on dry matter distribution at different periods of growth as relates to the whole soybean plant (mean of two seasons).

Treatments		Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)							
Days of sowing	Organs	Control	GA_3 (ppm)			Alar (ppm)			Irrig. X̄	Control	GA_3 (ppm)			Alar (ppm)			Irrig. X̄	Control	GA_3 (ppm)			Alar (ppm)			Irrig. X̄
			100	200	X̄	1000	2000	X̄			100	200	X̄	1000	2000	X̄			100	200	X̄	1000	2000	X̄	
50 days	Root	11.3	11.9	11.8	11.7	10.7	9.0	10.3	11.0	13.5	11.4	8.3	11.1	12.3	14.6	13.5	12.3	12.8	13.3	13.5	13.2	13.8	13.5	13.4	13.3
	Stem	24.3	28.8	32.3	28.5	25.2	25.2	24.9	26.7	27.1	25.4	23.4	25.3	29.2	29.2	28.5	26.9	28.2	25.6	31.5	28.4	27.6	28.4	28.1	28.3
	L. petiols	16.5	15.0	12.6	14.7	16.0	15.3	15.9	15.3	16.7	15.8	9.0	13.8	16.0	15.7	16.1	15.0	14.1	15.6	13.5	14.4	14.9	17.6	15.5	15.0
	L. blades	47.8	44.0	43.3	45.0	48.1	47.7	47.9	46.5	42.7	47.4	59.3	49.8	42.5	40.4	11.9	45.9	44.9	45.6	41.6	44.0	43.7	40.5	43.0	43.5
75 days	Root	7.9	8.6	7.9	8.1	8.2	10.0	8.7	8.4	10.2	7.8	9.4	9.1	8.2	10.1	9.5	9.3	11.3	11.6	12.3	11.7	13.3	11.8	12.1	11.9
	Stem	28.6	31.4	33.2	31.1	30.2	30.9	29.9	30.5	32.2	32.7	36.8	33.9	33.7	29.3	31.7	32.8	24.8	31.5	35.3	30.5	29.6	28.9	27.8	29.2
	L. petiols	14.4	14.7	13.8	14.3	15.9	17.9	16.1	16.0	15.1	13.3	12.6	13.7	14.1	16.3	15.2	14.5	16.3	16.7	13.9	15.6	15.3	13.2	14.9	15.3
	L. blades	25.3	25.0	23.8	24.7	24.3	27.3	25.6	25.2	27.8	25.4	23.1	25.4	27.5	27.4	27.6	26.5	33.3	25.5	28.9	29.2	26.5	31.6	30.5	29.9
	Pods	23.7	20.4	21.3	21.8	21.5	13.9	19.7	20.8	14.6	20.8	18.1	17.8	16.5	16.8	16.0	16.9	14.2	14.8	9.6	12.9	15.3	14.5	14.7	13.8
100 days	Root	7.1	6.7	6.4	6.7	6.4	7.3	6.9	6.8	8.2	6.8	6.3	7.1	8.0	9.8	8.7	7.9	8.0	7.9	10.3	8.7	10.7	9.8	9.5	9.1
	Stem	29.6	29.8	32.5	30.6	29.4	32.2	30.4	30.5	23.4	25.1	33.0	27.2	26.1	27.7	25.7	26.5	21.3	27.0	24.4	24.2	25.9	21.8	23.0	23.7
	L. petiols	11.6	13.6	12.1	12.4	13.7	12.8	12.7	12.6	10.6	11.6	8.7	10.3	10.9	12.7	11.4	10.9	12.4	12.7	11.8	12.3	13.6	11.6	12.5	12.4
	L. blades	22.8	21.4	21.8	22.0	21.6	22.0	22.1	22.1	24.2	20.3	15.4	20.0	19.9	20.2	21.4	20.7	22.7	20.3	24.0	22.3	21.7	24.0	22.8	22.6
	Pods	28.9	28.5	27.2	28.2	28.9	25.6	27.8	28.0	33.7	36.2	36.6	35.5	35.0	29.6	32.8	34.2	35.6	32.1	29.5	32.4	28.2	32.9	32.2	32.3

may be interpreted on the assumption that soybean plant directed its effort to stimulate leaves in the first growth period (50 days). Whereas, plant directed its growth in building up its stem through the period extended from 50 up 75 days after sowing. At later stages (100 days), soybean plant tend to build up its reproductive and storage organ i.e. pods. In other words, dry matter is redistributed from leaves either to the developing stem during the second period (75 days) or to the formation of the reproductive organ (pods) at later periods of growth. Such results may be explained on the basis that there is a regulating mechanism that redistributes dry matter within plant parts and that depends on the character of vegetative and reproductive growth period.

Regarding the effect of water defecit on dry matter distribution, data indicate that it regulates the percentage distribution within the plant organs. It was observed that the proportion of root dry matter increased with increasing soil moisture stress. However, leaf blade decreased by water deficit. Such findings can be discussed on the assumption that under water deficiency, the plant directed its effort for increasing the proportion of water absorping organ i.e. root and decreasing the transpiring area i.e. leaf blade. In other words, the plant regulates the balance between the different organs according to the environmental conditions. Under water deficit the plant increased the absorption area as well as decreasing the transpiring area to face the problem of water shortage.

As for the role of growth substances, it can be mentioned that Alar stimulated slightly the proportion of root dry weight compared with GA_3 during different periods of growth, while other plant organs were decreased. Such results may indicate that Alar application affected the percentage distribution of dry matter within plant organs. These results showed that the retarding effect of Alar on shoot growth did result in increasing root growth, thereby its dry matter content. On the contrary, GA_3 treated plant, showed a slight reduction on percentage of dry matter of roots on the account of the increase in the other organs. These results indicate that GA_3 increased shoot growth of treated plants than roots.

It is worthy to mention that, the effect of growth substances on dry matter distribution within different plant organs depends on the available soil moisture. Growth promoting substances act very well under wet conditions, while retardants needs dry conditions to affect the growth of treated plants. All of these affect the percentage distribution of dry matter within different plant parts. In this connection, Anton (1991) pointed out that growth substances may affect the nature of regulating mechanism which finally reflected on the distribution of dry matter accumulation.

4.2. Soybean Yield :

4.2.1. Yield component :

Yield component of soybean during the period of study as affected by soil moisture levels and growth substances are shown in Table (13). Mean values of the two seasons were analyzed statistically and presented in Table (13).

Table (13) : Effect of soil moisture levels and some growth reguators on yield component of soybean plant.

Treatments	Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)								L.S.D. at 5%		
	Control	GA_3 (ppm)			Alar (ppm)			Irrig. X̄	Control	GA_3 (ppm)			Alar (ppm)			Irrig. X̄	Control	GA_3 (ppm)			Alar (ppm)			Irrig. X̄	Irriga-tion	Growth Sub.	Concen-tration
		100	200	X̄	1000	2000	X̄			100	200	X̄	1000	2000	X̄			100	200	X̄	1000	2000	X̄				
Season 1988																											
No. of branches/plant	3.1	5.1	3.7	4.0	3.3	2.5	3.0	3.5	2.3	4.9	3.3	3.5	3.0	1.6	2.3	3.0	2.0	3.7	3.1	2.9	2.7	1.4	2.0	2.5	0.2	0.2	0.2
No. of pods/plant	49.3	64.3	59.0	57.6	54.7	53.7	52.6	55.1	45.0	53.3	50.0	49.4	48.3	46.7	46.7	48.1	40.0	48.7	45.0	44.6	44.0	38.0	40.7	48.1	1.7	1.4	1.7
Weight of seeds g./plant	15.4	19.0	15.6	16.7	16.4	11.8	14.5	15.6	12.7	15.3	14.1	14.0	14.4	10.8	12.6	13.3	10.9	10.5	10.1	10.5	9.4	8.2	9.5	10.0	0.8	0.7	0.8
Seed Index	17.2	17.4	16.9	17.2	16.3	16.6	16.7	17.0	16.3	17.0	16.7	16.7	16.1	16.5	16.3	16.5	15.5	16.5	16.3	16.1	15.3	15.7	15.5	15.8	0.4	0.3	N.S.
Weight of whole plant	57.5	74.7	65.3	65.8	64.4	51.0	57.6	61.7	39.7	56.9	49.9	48.8	47.9	36.2	41.3	45.1	29.7	37.6	35.4	34.2	31.4	21.3	27.5	30.9	3.0	2.5	3.0
Season 1989																											
No. of branches/plant	3.9	6.3	4.8	5.0	4.3	2.4	3.5	4.3	2.4	5.1	4.4	4.0	3.8	1.4	2.5	3.3	2.3	4.2	3.9	3.5	3.0	1.3	2.2	2.9	0.5	0.4	0.5
No. of pods/plant	69.7	76.3	71.0	72.3	70.0	64.3	68.0	70.2	61.0	66.3	65.3	64.2	63.7	51.7	58.8	61.5	32.0	43.0	37.7	37.6	39.0	37.3	36.1	36.9	2.9	2.3	2.9
Weight of seeds g./plant	17.1	23.5	19.2	19.9	17.1	16.3	16.8	18.4	15.1	18.2	17.1	16.8	14.5	12.5	14.0	15.4	9.9	13.5	12.9	12.1	13.4	12.1	11.8	12.0	0.8	0.6	0.8
Seed Index	15.1	17.1	16.5	16.2	15.2	17.0	15.8	16.0	15.0	15.8	15.4	15.4	15.0	15.3	15.1	15.3	14.0	13.9	14.0	14.0	14.5	13.8	14.1	14.1	0.4	N.S.	0.4
Weight of whole plant	64.7	90.1	81.3	78.7	74.1	63.6	67.5	73.1	50.1	62.1	56.2	56.1	48.3	41.8	46.7	51.4	33.8	45.6	46.3	41.9	45.5	39.7	39.7	40.8	2.7	2.2	2.7
Mean of two seasons																											
No. of branches/plant	3.5	5.9	4.3	4.5	3.8	2.5	3.3	3.9	2.4	5.0	3.9	3.8	3.4	1.5	2.4	3.1	2.2	4.0	3.5	3.2	2.9	1.4	2.2	2.7	0.1	0.1	N.S.
No. of pods/plant	59.5	70.3	65.0	64.9	62.4	59.0	60.3	62.6	53.0	59.8	58.0	56.9	56.0	49.2	52.9	54.8	36.0	45.9	41.4	41.1	41.5	37.7	38.4	39.8	1.6	N.S.	N.S.
Weight of seeds g./plant	16.3	21.3	17.4	18.3	16.8	14.1	15.7	17.0	13.9	16.8	15.6	15.4	14.5	11.7	13.4	14.4	10.4	12.0	11.5	11.3	11.4	10.2	10.7	11.0	0.4	0.3	0.4
Seed Index	16.2	17.3	16.7	16.7	15.8	16.8	16.3	16.5	15.7	16.4	16.1	16.1	15.6	15.9	15.7	15.9	14.8	15.2	15.2	15.1	14.9	14.8	14.8	15.0	0.2	N.S.	N.S.
Weight of whole plant	61.1	82.4	73.3	72.3	69.3	57.3	62.6	67.5	44.9	59.5	53.1	52.5	48.1	39.0	44.0	48.3	31.8	41.6	39.2	37.5	38.5	30.5	33.6	33.6	1.2	1.0	1.2

4.2.1.1. Number of branches/plant :

Number of lateral branches/plant as influenced by soil moisture levels are presented in Table (13). Statistical analysis showed that soil moisture stress had a significant effect upon such character. This result was found to true in both seasons as well as the combined analysis of both seasons. Lateral branches/plant decreased by increasing water deficit. These results indicate that water deficit affected significantly the formation of lateral branches. The plants minimized their shoot system under dry conditions by reducing the transpiring area. Therefore, they can survive under drought. The previous results are in line with those reported by Abbas (1988) who concluded that number of branches increased under wet conditions and decreased by increasing soil moisture stress.

The application of GA_3 stimulated significantly the formation of lateral branches, while Alar retarded the formation of branches. The highest number of branches/plant was gained from plants sprayed with 100 ppm GA_3. However, the lowest values were obtained from plants sprayed with 2000 ppm Alar. Accordingly, it can be concluded that both growth substances controlled the formation of branches beside their effect on vegetative growth.

It is worthy to mention that soil moisture levels interfer with the regulating effect of growth substances. The stimulative effect of GA_3 or the retardation caused by Alar application on number of branches/plant seemed to be decreased with increasing soil moisture stress. These results may prove that the regulating effect of growth substances can be controlled by the available soil moisture. In this connection, Baza (1985) concluded that foliar application of GA_3 significantly increased number of branches/plant at all growth stages.

4.2.1.2. Number of pods/plant :

The results in Table (13) indicate that soil moisture levels affected significantly number of bods/plant. Increasing water deficit did result in a significant reduction in the formation of pods. Such character is connected with the growth of the plant. Soil moisture stress has a great influence on the growth of soybean plant and that was reflected on the formation of pods. Maximum values of number of pods/plant were gained from wet treatment followed by the medium level whereas the least values were produced from the dry one. These results are in full agreement with those reported by Abbas (1988) who concluded that dry matter accumulation is favoured by wet conditions and consequently increased number of pods/plant.

With regards to growth substances, data of Table (13) showed that GA_3 stimulated the formation of pods while Alar retards such character. GA_3 seemed to stimulate the formation of pods and that was more pronounced when GA_3 was used at the rate of 100 ppm than when applied at 200 ppm. These results might be attributed to the effect of GA_3 in decreasing flower shedding (Huff and Dybing; 1980) and in increasing growth and period of flowering (Castro and Vello, 1981). The previous results are in line with those pointed out by Baza (1985) who concluded that number of pods/plant increased significantly by foliar application of 50 ppm GA_3 and decreased by increasing the rate of GA_3.

Alar seemed to retard pod formation and this retardation increased by increasing the rate of application from 1000 up to 2000 ppm.

It is worthy to mention that soil moisture levels affect the regulating action of growth substances either stimulation or retardation with respect to number of pods/plant. Growth promoter i.e. GA_3 needs wet conditions for enhancing pod formation, while retardants (Alar) act very well under dry soil moisture levels. In other words, GA_3 increased pod formation under high soil moisture level compared with those plants imposed to water deficit. However, Alar reduced number of pods/plant under dry conditions rather than under frequent irrigations.

4.2.1.3. Weight of seeds/plant :

Data in Table (13) showed that soil moisture levels had a significant response on weight of seeds/plant. The highest soil moisture level produced the maximum values followed by the medium level and the lowest values were gained from dry treatment (55 % field capacity). The increase in weight of seeds/plant observed in wet treatment was found to be significant compared with other irrigation treatments. Such results are in agreement with those reported by Abbas (1988).

Regarding the effect of growth substances, results showed a similar trend to that observed with number of pods/plant. GA_3 application increased the weight of seeds/plant. The most pronounced concentration was found to be 100 ppm. However, more than that level decreases the weight of seeds/plant compared with the lower rate but still greater when compared with the control treatment. These results might be attributed to the significant effect of GA_3 on the number of pods/plant. These results are in full agreement with those found by Baza (1985).

As for Alar, results indicate that it decreased significantly the weight of seeds/plant. Such reduction was found to be clear with higher concentration. However, the lower rate of Alar increased slightly the weight of seeds/plant. Such increase was found to be insignificant compared with the control treatment. The reduction in weight of seeds/plant after Alar application might be ascribed to the retarding effect of such chemical on soybean growth. Also, number of pods/plant was less in these treatments which was reflected on weight of seeds/ plant.

The values of weight of seeds/plant in growth substances treatment under different soil moisture levels behave in a similar manner to that observed with number of pods/plant.

4.2.1.4. Seed Index :

Data in Table (13) show that soil moisture levels has a significant effect on weight of 100 seeds (seed index). Maximum seed mass was scored from high soil moisture levels and lowest value from the dry treatment whereas the medium soil moisture treatment falls in between. These results reveal that increasing soil moisture stress did result in producing smaller seeds and lighter in their mass. Such decrease was found to be significant. The previous findings indicate the importance of soil water for increasing the volume of soybean seeds and heaviest in their mass. These reults are in full agreement with those reported by Sherif (1983) and Abbas (1988).

Foliar application of GA_3 increased weight of 100 seeds (seed index) as compared with the control. The most pronounced rate was found to be 100 ppm, while more than that. level slightly decreased seed mass. Such increase was found to be significant in one season and insignificant in the second year. These findings can be attributed to the enhancing effect of such promoter on the accumulation of dry matter which in turn produced larger seeds and heavier in their mass. These results had been comfirmed by Baza (1985).

As for the effect of Alar, results showed no effect on seed index. However, a slight decrease in seed mass was observed by the application of Alar. The interaction between soil moisture levels and growth substances was found to be insignificant. These results means that both factors act independently on weight of 100 seeds (seed index).

4.2.2. Seed yield :

Results of seed yield expressed as Kg./feddan as influenced by soil moisture levels and growth regulators are presented in Table (14). Statistical analysis of variance proved that both factors had a significant response on seed yield of soybean in the two seasons as well as the combined analysis. The data show that the wet treatment (irrigated at 85 % F.C.) produced the maximum yield followed by the medium level (75 % F.C.) and the least production was gained from the dry one (irrigated at 55 % F.C.) The differences between

Table (14): Effect of soil moisture levels and some growth regulators on the yield of soybean plant (Kg./feddan).

Treatments	Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)								L.S.D. at 5 %		
	Control	GA_3 (ppm)			Alar (ppm)			Irrig. X̄	Control	GA_3 (ppm)			Alar (ppm)			Irrig. X̄	Control	GA_3 (ppm)			Alar (ppm)			Irrig. X̄	Irrigation	Growths	Concentration
		100	200	X̄	1000	2000	X̄			100	200	X̄	1000	2000	X̄			100	200	X̄	1000	2000	X̄				
Season 1988																											
Seed yield	1207	1320	1277	1268	1150	825	1061	1165	793	1073	970	945	1007	757	852	899	667	733	707	702	660	435	587	645	60	49	60
Straw yield	2816	3587	3083	3162	2677	2115	2536	2849	2007	2910	2497	2472	2346	1776	2043	2257	1403	1884	1906	1731	1238	1058	1238	1484	166	136	166
Biological yield	4023	4907	4360	4430	3827	2940	3597	4014	2800	3983	3467	3417	3353	2533	2895	3156	2070	2617	2613	2433	1913	1493	1825	2129	210	170	210
Harvest index	30.0	26.9	29.3	28.6	30.0	28.1	29.5	29.0	28.3	26.9	28.0	27.7	30.0	29.9	29.4	28.5	32.2	28.0	27.1	28.9	34.5	29.1	32.2	30.3			
Season 1989																											
Seed yield	1303	1874	1342	1506	1195	1139	1212	1359	1164	1272	1201	1212	1015	879	1019	1116	855	947	903	902	808	744	802	852	59	48	59
Straw yield	3090	4436	3091	3539	2775	2658	2841	3190	2763	3078	2756	2866	2365	2084	2404	2635	2030	2243	2107	2127	1914	1563	1836	1982	149	121	149
Biological yield	4393	6310	4433	5045	3970	3797	4053	4549	3927	4350	3957	4078	3380	2963	3423	3751	2885	3190	3010	3028	2722	2307	2638	2833	198	161	198
Harvest index	29.7	29.7	30.3	29.9	30.1	30.0	29.9	29.9	29.6	29.2	30.4	29.7	30.0	29.7	29.8	29.8	29.6	29.7	30.0	29.8	29.7	32.2	30.4	30.1			
Mean of two seasons																											
Seed yield	1255	1597	1310	1387	1173	982	1137	1262	979	1172	1086	1079	1011	818	936	1008	761	840	805	802	734	590	695	749	44	36	44
Straw yield	2953	4012	3087	3351	2726	2387	2688	3020	2385	2995	2656	2669	2356	1930	2223	2446	1717	2064	2007	1929	1585	1304	1535	1732	78	64	78
Biological yield	4208	5609	4397	4738	3899	3369	3825	4282	3364	4167	3712	3748	3367	2748	3159	3454	2478	2904	2812	2731	2319	1894	2230	2481	119	97	119
Harvest index	29.8	28.5	29.8	29.3	30.1	29.1	29.7	29.5	29.1	28.1	29.3	38.8	30.0	29.8	29.6	29.2	31.0	28.9	28.6	29.4	31.7	31.2	31.2	30.2			

the wet treatment and the other two soil moisture levels was found to be significant. These results indicate the importance of maintaining soil water at a high level for maximizing soybean yield. Such findings may be due to multiple effect of water deficit on soybean growth which in turn was reflected on seed production. The previous results are in full agreement with these reported by Sherif (1983) and Abbas (1988).

In this respect, Dharmasena (1985) pointed out that water availability affects germination, vegetative growth, and pod-filling. Water stress during the pod-filling stage may result in higher yield reduction than stress during harvesting.

Concerning the role of growth substances on soybean yield, results of Table (14) showed that foliar spray of GA_3 did result in a significant increase in seed production. This trend was found to be clear in the two tested seasons as well as the combined analysis of the two seasons. These results are expected since GA_3 stimulated the growth of soybean. Also, it has been mentioned previously that GA_3 application affected significantly most of the tested yield component. The increase in soybean yield following GA_3 application could be explained through its role on the mobilization of nitrogenous compounds to the developing seeds, probably through GA_3 induced enzyme system and the interaction with cytokinins. It is worthy to mention that the most pronounced concentration was found to be 100 ppm,. The higher level, decreased seed yield compared with the lower one. Moreover, the higher level (200 ppm) increased seed yield of soybean plant without any significant differences compared with the control.

Regarding the role of Alar on seed yield of soybean, results of Table (14) showed that spraying Alar on soybean plant failed to cause any increase in seed yield but significantly decreased it compared with control. Such reduction in seed yield was found to be obvious under higher concentration. In other words, the depressive effect following Alar application seemed to be clear with higher rate i.e., 2000 ppm rather than the lower used one (1000 ppm). These results can be ascribed to the retarding effect caused by Alar. It has been found previously that such growth substance retard the growth behaviour of soybean plant which was reflected on either the tested yield component or final seed yield.

Comparing the combined effect between growth regulators and soil moisture levels, it can be noticed that the promotive effect of GA_3 was found to be very clear under wet and medium soil moisture levels. However, under severe water deficit, the stimulating effect of such substances in seed production was decreased or inhibited. In other words, under severe soil moisture stress or dry conditions, growth promoting substances had a slight enhancing effect on seed production of soybean. In this connection, Kramer, (1969) concluded that the reduced synthesis of growth regulators such as cytokinins and Gibberellins in the root is an important factor in the reduction of growth observed in plants subjected to water stress. Also, Nowakowski and Lubanska (1975) pointed out that GA_3 increased photosynthetic intensity of plants under high soil moisture level, while had no effect at low water level. The same conclusion had been stated by Miseha (1983).

However, in case of Alar (a growth retardant) the retarding effect was found to be clear by increasing water deficit and the rate of application. In other words, the reduction in seed yield was found to be greater under high rate of Alar and severe water stress. Such decrease can be related to the reduced growth of soybean plants by the two factors. It has been mentioned previously that both factors i.e., water deficit and Alar application affect the growth and other tested yield components of soybean plant.

4.2.3. Straw yield :

Results of Table (14) showed the straw yield under the various streatments. The trend of straw yield is identical to that observed with seed yield. Analysis of variance showed that either irrigation treatments or growth substances had a significant effect upon straw production. There was a positive association between moisture levels and straw production of soybean. The wet treatment produced the maximum values of straw followed by the medium water deficit and the least straw yield was gained from the prolonged irrigation intervals. These results demonstrate the importance of soil water for the growth of soybean thereby straw production.

As for the growth substances, results indicate that GA_3 application increased straw yield significantly over the control or those plots treated with Alar. These results may prove that growth promoting substances had an additive effect for enhancing the vegetative growth of soybean and that was reflected on straw yield. Such stimulation was found to be more than that observed in case of seed yield. The rverse trend was found to be true with growth retardant i.e. Alar. In other words, the use of Alar decreased significantly straw yield of soybean. These results can be ascribed to the effect of such chemical on the growth of plants which was reflected on straw production.

4.2.4. Harvest index :

Data of Table (14) represent the effect of different treatments on the harvet index. It is clear that either soil moisture levels or growth substances had no effect upon such character and the values are about the same. These findings show that seed yield and straw yield are proportional to each other. In other words, any increase in straw yield was followed by a similar increase in seed yield and the reverse was true. The results indicate that factors affecting the growth of soybean plant-either by stimulation or retardation-had the same effect as yield production, such pattern resulted in no changes on harvest index.

4.2.5. Oil Yield :

4.2.5.1. Oil content :

Results of Table (15) represent the effect of soil moisture levels and some growth regulators on soybean content. Statistical analysis showed that both factors i.e., water deficit and growth substances had a significant effect on oil content of soybean seeds.

The highest values of oil content were scored from the high

Table (15) : Effect of soil moisture levels and some growth regulators on oil production.

Treatments	Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)								L.S.D. at 5 %		
	Control	GA_3 (ppm)			Alar (ppm)			Irrig. X̄	Control	GA_3 (ppm)			Alar (ppm)			Irrig. X̄	Control	GA_3 (ppm)			Alar (ppm)			Irrig. X̄	Irrigation	Growth Sub.	Concentration
		100	200	X̄	1000	2000	X̄			100	200	X̄	1000	2000	X̄			100	200	X̄	1000	2000	X̄				
Season 1988																											
Oil (%)	22.0	23.2	25.0	23.4	22.3	21.0	21.8	22.6	21.0	21.6	24.0	22.2	20.8	20.0	20.6	21.4	19.3	20.3	22.0	20.5	19.0	18.9	19.1	19.8	0.7	0.5	0.7
Oil production Kg/feddan	264	306	244	272	257	174	232	252	166	232	233	210	209	151	176	193	177	149	156	161	165	145	162	162	12	10	12
Season 1989																											
Oil (%)	23.0	24.1	25.0	24.0	23.3	22.0	22.8	23.4	21.3	22.0	23.0	22.1	21.0	21.0	21.1	21.6	20.7	21.0	21.4	21.0	20.4	19.5	20.2	20.6	0.8	0.6	N.S.
Oil production Kg./feddan	229	384	335	339	278	251	276	308	249	280	277	268	213	184	215	242	114	200	193	169	125	165	135	152	20	16	20
Mean of Two Seasons																											
Oil (%)	22.5	23.7	25.0	23.7	22.8	21.5	22.3	23.0	21.2	21.8	23.5	22.2	20.9	20.5	20.9	21.5	20.0	20.7	21.7	20.8	19.7	19.2	19.6	20.2	0.4	0.3	0.4
Oil production Kg./feddan	282	345	290	305	268	212	254	280	208	256	255	239	211	168	195	217	146	175	175	165	145	155	149	157	10	8	10

soil moisture level (iirigated at 85 % F.C.) and the least value of seed oil content was gained from the severe moisture stress (prolonged irrigation intervals), while the medium water level (iirgated at 70% F.C.) falls in between. The differences between the wet treatment and other irrigation levels were found to be significant. This pattern was found to be true in both seasons under study.

These results may prove the importance of maintaing soil water at a high level for increasing oil content of soybean seeds. In other words increasing water deficit did result in a significant decrease in oil content of seeds. These results can be ascribed to the stimulative effect of wet conditions on the biosynthesis of carbohydrates and the transformation of sugars to fatty acids in seeds.

These results are in harmony those there reported by El-Wakil (1979), Sherif (1983) and Abbas (1988), who pointed out that seed oil content increased as soil moisture stress decreased.

With regard to the role of growth substances, results of Table (15) indicate that GA_3 application increased oil content of soybean seeds significantly over the control. Increasing GA_3 concentration did result in a significant increase in seed oil content of soybean seeds. Such trend can be related to the enhancing effect of GA_3 on carbohydrate sy nthesis thereby on oil content. These results are in agreement with those reported by Bdorov, 1973; and Rao, (1975) who concluded that the application of GA_3 increased seed oil content of many treated plant species.

As for Alar, data clearly indicate that such chemical seemed to decrease seed oil content of soybean. Increasing the rate of application resulted in a significant decrease in oil content. This trend was found to be true under the three moisture levels. This phenomenon can be ascribed to the inhibiting effect of the growth retardant (Alar) on the growth of plants which was reflected on carbohydrate biosynthesis and thereby on oil formation.

4.2.5.2. Oil production :

Table (15) demonstrate the effect of soil moisture levels and growth regulators on oil production by soybean plant. Data clearly indicate that both factors i.e. soil moisture levels and growth substances had a significant response similar to that observed with seed yield. Oil production increased by high soil moisture level and decreased by water deficit. The wet treatment produced the highest oil yield followed by the medium level and lowest oil production was gained under dry conditions or prolonged irrigation intervals. This trend is similar to that observed with seed yield.

As for the role of growth regulators, GA_3 application enhanced oil production. The most pronounced concentration was found to be 100 ppm. The higher rate of GA_3 seemed to decrease oil production compared with the low level. On the contrary, the use of growth retardant (Alar) decreased oil yield and such decrease was increased by higher rate of Alar.

4.3. Evapo transpiration :

Evapotranspiration from a plant-soil is proportional to the vapour gradient between the surface and free air above the surface and inversely proportional to the resistance of the diffusion pathway. The vapour pressure at the plant or soil surface which in turn is a function of the surface energy budget.

4.3.1. Seasonal values :

Seasonal water consumptive use of soybean plant under the various treatments during the period of study is presented in Tables (16 & 17). Results indicate that seasonal evapotranspiration vary widely between 51.51 and 83.99 cm in the first season, while ranged from 49.57 to 84.09 cm. in the second season. There are a slight variation in water consumptive use values in the two seasons. Such differences are mainly due to variations in climatic factors observed in the two seasons. In this respect, Jensen (1968), concluded that crops would not necessarly require the same amounts of water when grown under widely different climatic conditions. Water requirements of a crop can not be discussed without considering the crop season and potential evapotranspiration. The above results are in agreement with those reported by Doorenbos and Pruitt (1977), Sherif (1983) and Abbas (1988). They mentioned that water consumptive use by soybean ranged from 450 - 840 mm and that depends on climate and crop season.

Results of Tables (16 & 17) showed that water consumption increased as soil moisture stress decreased. The highest evapotranspiration

Table (16) : Effect of soil moisture levels and growth regulators on evapotranspiration rates (cm) of soybean during season 1988.

Treatments			Semi monthly ET in cm.								
			1	2	3	4	5	6	7	8	Total
Control			4.18	4.80	9.30	12.30	13.12	13.80	13.12	8.80	79.42
Wet (85% F.C.)	GA_3 (ppm)	100	4.18	4.95	10.05	12.90	14.40	14.55	12.96	10.00	83.99
		200	4.18	4.80	9.90	12.45	13.60	14.25	13.60	9.20	81.98
	Alar (ppm)	1000	4.18	4.65	9.75	11.85	12.64	12.00	11.04	8.60	74.71
		2000	4.18	4.50	9.30	11.55	12.48	11.85	10.88	8.20	72.94
Control			4.18	4.80	8.40	10.50	11.20	10.20	10.24	7.40	66.92
Medium (70% F.C.)	GA_3 (ppm)	100	4.18	4.95	8.70	10.80	11.68	12.60	10.72	7.60	71.23
		200	4.18	4.65	8.55	10.50	11.68	12.75	10.40	6.80	69.51
	Alar (ppm)	1000	4.18	4.50	8.25	10.35	11.04	10.20	10.24	7.00	65.76
		2000	4.18	4.35	8.10	10.05	11.04	10.65	9.76	6.20	64.33
Control			4.18	4.35	7.35	7.95	8.48	7.95	7.68	6.60	54.54
Dry (55% F.C.)	GA_3 (ppm)	100	4.18	4.35	8.25	8.25	8.96	8.85	8.00	6.80	57.64
		200	4.18	4.35	7.80	7.95	8.80	8.40	7.84	6.80	56.12
	Alar (ppm)	1000	4.18	4.35	6.45	7.80	8.32	7.95	7.36	5.80	52.21
		2000	4.18	4.35	6.30	7.80	8.32	7.80	7.36	5.40	51.51

Table (17) : Effect of soil moisture levels and growth regulators on evapotranspiration rates (cm) of soybean during season 1989.

Treatments			Semi monthly ET in cm.								
			1	2	3	4	5	6	7	8	Total
Control			4.41	6.30	9.45	11.85	13.60	12.00	11.84	8.97	78.42
Wet (85% F.C.)	GA_3 (ppm)	100	4.41	6.60	10.95	12.60	14.40	13.35	12.16	9.89	84.09
		200	4.41	6.45	10.65	12.30	13.44	13.20	12.00	9.43	81.88
	Alar (ppm)	1000	4.41	6.15	8.85	11.55	12.48	11.55	10.88	9.20	75.07
		2000	4.41	6.00	8.70	11.10	12.00	10.95	9.92	8.97	72.05
Control			4.41	4.90	9.00	10.50	12.80	10.65	10.24	8.28	70.78
Medium (70% F.C.)	GA_3 (ppm)	100	4.41	5.25	10.05	12.15	13.76	11.85	11.36	8.97	77.80
		200	4.41	5.10	9.90	11.85	13.44	11.55	10.88	8.51	75.64
	Alar (ppm)	1000	4.41	4.80	8.85	10.50	12.00	10.95	10.24	8.05	69.80
		2000	4.41	4.65	8.55	10.05	11.68	10.50	9.60	7.82	67.26
Control			4.41	4.35	5.85	6.90	9.28	8.10	7.68	6.21	57.51
Dry (55% F.C.)	GA_3 (ppm)	100	4.41	4.35	6.15	7.50	9.76	8.85	8.00	6.44	55.46
		200	4.41	4.35	6.00	7.05	9.44	8.10	7.84	6.21	53.40
	Alar (ppm)	1000	4.41	4.35	5.70	6.60	9.12	7.80	7.52	5.52	51.02
		2000	4.41	4.35	5.40	6.30	9.12	7.50	7.20	5.29	49.57

rate was brought about under wet conditions (frequent irrigations, 85 % Field capacity), whereas the lowest water use was attained under prolonged irrigation intervals (55 % field capacity), while under medium water supply, the values falls in between. This trend shows that the increase in water consumption depends on the available soil moisture in the root zone As soil moisture was kept wet by frequent irrigations, maximum water use was attained. This trend can be attributed to the availability of water to the plants as well as to the high evaporation opportunity from a wet rather than a dry one.

In this connection, Thronthwaite and Mather (1955) suggested a linear decline in evapotranspiration with increasing soil moisture tension. Tanner et al. (1960) stated that total evapotranspiration depends on the availability of water for both plants and at the soil surface. When water is readily available to plants, maximum evapotranspiration obtains. Wiegand (1962) pointed out that the drying rate of a soil is proportional to the water content and inversely proportional to time and a drying front advances into the soil linearly with time. Also, Shaw and Laing (1965) pointed out that under stress conditions, transpiration is reduced when water deficit reached a critical value characteristic for the species, turger induced changes in stomatal operature which causes an incrase in the resistance to transpiration in the gaseous phase, the resultant is reduction in transpiration to prevent or limit dessication rather than to maintain flow at the level of evaporation demand. Ibrahim (1981) concluded that the increase in evapotranspiration rate by maintaining soil moisture at high level can be attributed to excess available water in the root zone to be consumed by plants.

The previous results are in full agreement with those reported by Sherif (1983), Abbas (1988) and Yousef (1989). They mentioned that more frequent irrigation provides a chance for more luxurient use of water.

In case of growth substances, results recorded in Tables (16, 17) indicate that GA_3 application, increased seasonal water consumption by soybean irrespective to the effect of soil moisture level. It is interesting to mention that increasing GA_3 rate resulted in decreasing seasonal water consumption by soybean compared with the lower rate (100 ppm). However, the higher GA_3 rate showed higher evapotranspiration than the control. Such trend can be explained on the basis that GA_3 interacts with cytokinins. The increase in seasonal ET. values observed with plants treated with GA_3 may be due to its effect on promoting the growth of soybean plant and increasing the transpiring surface (leaf area) which was reflected on the values of seasonal water consumption.

In this connection, Livne and Vaadia (1965) concluded that cytokinins and apparently also Gibberellic acid are unique among the compounds which affect stomatal opening in that they simultaneously promote stomatal opening and other physiological processes. Kinetin enhances transpiration rate and the opening of stomata.

The above mentioned results are in full agreement with those found by Eweida et al (1978), Seif El-Yazal (1983) and Miseha (1983) who recorded an increase in seasonal evapotranspiration rates by the application of 2, 4-D and GA_3.

In case of Alar, a reverse trend to that observed with GA_3 was found with respect to seasonal water consumption by soybean plant. The use of Alar did result in decreasing evapotranspiration by soybean and the higher the rate of Alar used the lower are the values of ET. This trend of finding may be due to the retarding effect of such chemical or the growth of treated plants. It has been previously mentioned that the growth and leaf area of soybean was reduced by such treatment. Livne and Vaadia (1972) proposed that the increase in drought tolerance of plants treated with growth retardants might be related to the interference of those compounds with the biosynthesis of gibberelic acid. The lower level of GA_3 in the treated plants could reduce stomatal opening and hence lower transpiration. These findings are in agreement with those reported by Miseha (1983) who found that seasonal water consumptive use was lower for plants treated with growth retardants.

It is worthy to mention that the increase or decrease in seasonal evapotranspiration by soybean plant observed in the plots treated with growth substances was found to be more under wet conditions (frequent irrigation) rather than under severe water deficit (prolonged irrigation intervals). This trend indicates that the reflect of soil moisture stress on transpiration is more pronounced than the role of growth substances. In other words, water deficit has a considerable effect on stomatal behaviour than the modifications, caused by growth regulators with respect to transp .ration

In this respect, Black (1965) pointed out that the independance of evapotranspiration and density of vegetation canopy exist for different reasons where soil is dry than where availability of water for evaporation and transp ration is unlimited. Under moist soil, the control is in the atmosphere, under dry conditions the control is in the soil-under intermediate conditions, the control may be partly in the soil and partly in the plants. Also, Miseha (1983) concluded that by decreasing availability of water, the plant reduces the stomatal operature considerably, cutting down transpiration although photosynthesis is also reduced, the proportional drop is probably less than that for transpiration.

4.3.2. Daily Rates :

A summary of the effect of soil moisture levels and growth regulators on daily evapotranspiration by soybean plant as related to its growth cycle (as a percentage of growing season) are given in Table (18). Results indicate that the values started with lower amounts as the plants were small and intercept little of the net radiation. A gradual increase in the values of water use by soybean plant were observed as the plants developed. Such pattern of results can be ascribed to the vigrous growth of soybean plants. Thereafter, daily rates recorded its maximum when soybean plants complete 70 % of their growth period, then declined after that gradually to reach a minimum at harvest time. These results show that the increase in evapotranspiration

Table (18) : Effect of soil moisture levels and growth regulators on daily evpotranspiration of soybean (Mean of two seasons).

Treatments		Relative growth period										
		10	20	30	40	50	60	70	80	90	100	Mean
Wet (85 % F.C.)	Control	0.215	0.283	0.452	0.654	0.805	0.833	0.860	0.809	0.639	0.415	0.597
	GA_3	0.215	0.287	0.464	0.718	0.839	0.871	0.914	0.843	0.660	0.450	0.626
	Alar	0.215	0.276	0.440	0.621	0.768	0.775	0.774	0.616	0.496	0.408	0.539
	Mean	0.215	0.282	0.452	0.664	0.804	0.826	0.849	0.756	0.598	0.424	0.587
Medium (70 % F.C.)	Control	0.215	0.265	0.402	0.600	0.700	0.746	0.711	0.655	0.530	0.365	0.519
	GA_3	0.215	0.268	0.419	0.641	0.756	0.788	0.815	0.726	0.560	0.370	0.556
	Alar	0.215	0.255	0.384	0.582	0.683	0.713	0.815	0.655	0.512	0.338	0.515
	Mean	0.215	0.263	0.402	0.608	0.713	0.749	0.880	0.679	0.534	0.358	0.530
Dry (55 % F.C.)	Control	0.215	0.250	0.340	0.448	0.495	0.551	0.541	0.502	0.413	0.300	0.406
	GA_3	0.215	0.250	0.356	0.497	0.513	0.573	0.574	0.524	0.425	0.308	0.424
	Alar	0.215	0.250	0.325	0.411	0.475	0.540	0.526	0.482	0.384	0.258	0.389
	Mean	0.215	0.250	0.340	0.452	0.494	0.555	0.547	0.503	0.407	0.289	0.406

(Growth period = number of days from planting harvest time 130 days).

rate stood parallel to the increase in the percentage of crop cover. However, the decline in daily rates after reaching a maximum can be related to maturation.

In this connection, Lemon et al. (1959) reported that the gradual increase in evapotranspiration from planting to maturity can be explained on the basis of percent cover. The decrease in evapotranspiration after maturation is probably a plant-dependent factor. However, in many studies soil water is not maintained at a high level after maturation. Gates and Hanks (1967) concluded that plant factor undoubtedly influence evapotranspiration from a crop. The greatest difference among crops occurs during the growth period when the crop cover is 50 %. During this time, evapotranspiration of most irrigated crops is less than where cover is greater because evaporation from bare soil decreases faster than does transpiration by plant.

The previous results are in accordance with those reported by Sherif (1983), Abbas (1988) and Yousef (1989) who concluded that daily evapotranspiration rates by soybean were lower early in the season, and increased as the plants developed to reach a maximum when plants aged 70-100 days then declined after that.

soil moisture stress had a negative response on daily water use by soybean. As soil moisture stress increased by prolonged irrigation intervals a relative decrease in daily water consumption was observed. The use of growth promoting substance i.e., GA_3 did result in an obvious increase in daily water use by soybean irrespective to water deficit.

This trend can be related to the enhancing effect of such chemical on soybean growth as well as on transpiration. On the contrary, when concerning Alar treatments (a growth retardent), results showed an obvious decrease in daily evapotranspiration. This pattern may be due to the reduced growth by Alar beside its effect on theb iosynthesis of GA_3 in those plants treated with it. It has been prevously mentioned that soybean plant sprayed with Alar is shorter and less in vegetative growth. In this connection Gates and Hanks (1967) pointed out that plant height and size appears to influence evapotranspiration by greater interception of advected heat. Thus, plant height would affect evapotranspiration if the taller plants were isolated in a field.

In this respect, Miseha (1983) concluded that factors influencing resistance to evapotranspiration can be grouped into three categories:

1. The inftuence of degree of crop cover or canopy that affect diffusive resistance.

2. Maturation of the crop, including the development of seed heads above a crop can influence evapotranspiration by decreasing the portion of net radiation converted to latent heat of vaporization.

3. Net soil moisture stress prior irrigation can influence the effective diffusive resistance.

When considering the data of daily evapotranspiration by soybean plant, it seems advisable to represent the data as a continous function. The second class function relating the daily water consumptive use of soybean to its growth seasons (represented as a percentage) was found to be the best type of relation. These functions have the form :

$$Y = a + bX + CX^2$$

Where :

Y = daily evapotranspiration by soybean plant in mm/day.

X = relative growth period as a percentage.

a, b, c = are the parameters of the function.

The obtained functions under the three moisture levels i.e., 85, 70 and 55 % of field capacity as well as the growth regulators i.e., GA_3 or Alar are presented in Table (19). The values gained from using these functions are graphed and illustrated in Fig. (2)

These functions demonstrate that :

a. Growth cycle of the plant.

b. Net soil moisture prior irrigation.

c. the growth of the plant as modified by the type of growth regulators used.

each of those factors affect the daily water use by soybean. The variations observed in the parameters of the obtained functions (a, b, c) represent the effect of the aforementioned factors on the daily evapotranspiration of soybean. The period of maximum demand for water can be obtained by differentiating and equating the derivative with zero. This period was found to be from 81 - 83 days after sowing.

Table (19) : Daily evapotranspiration of soybean as a function of growth cycle under different soil moisture level and growth substances.

Treatments		Quadratic function $Y = a + bx + cx^2$; Y = daily ET. in mm.; x = growth period in percent	R^2	Maximum daily ET. for growth cycle	
				%	in days
Wet (85% F.C.)	Control	$Y_1 = -1.887 + 32.12 X - 25.49 X^2$	0.920	0.63	82
	GA_3	$Y_2 = -2.092 + 34.25 X - 27.23 X^2$	0.931	0.63	82
	Alar	$Y_3 = -1.263 + 28.34 X - 23.22 X^2$	0.886	0.61	79
Medium (70% F.C.)	Control	$Y_4 = -1.180 + 26.70 X - 21.60 X^2$	0.922	0.62	80
	GA_3	$Y_5 = -1.719 + 30.51 X - 24.70 X^2$	0.906	0.62	80
	Alar	$Y_6 = -1.483 + 27.88 X - 22.59 X^2$	0.867	0.61	80
Dry (55% F.C.)	Control	$Y_7 = 0.5703 + 16.74 X - 13.54 X^2$	0.888	0.62	80
	GA_3	$Y_8 = -0.1231 + 18.4 X - 14.97 X^2$	0.905	0.61	80
	Alar	$Y_9 = 0.3996 + 16.57 X - 13.71 X^2$	0.867	0.60	79

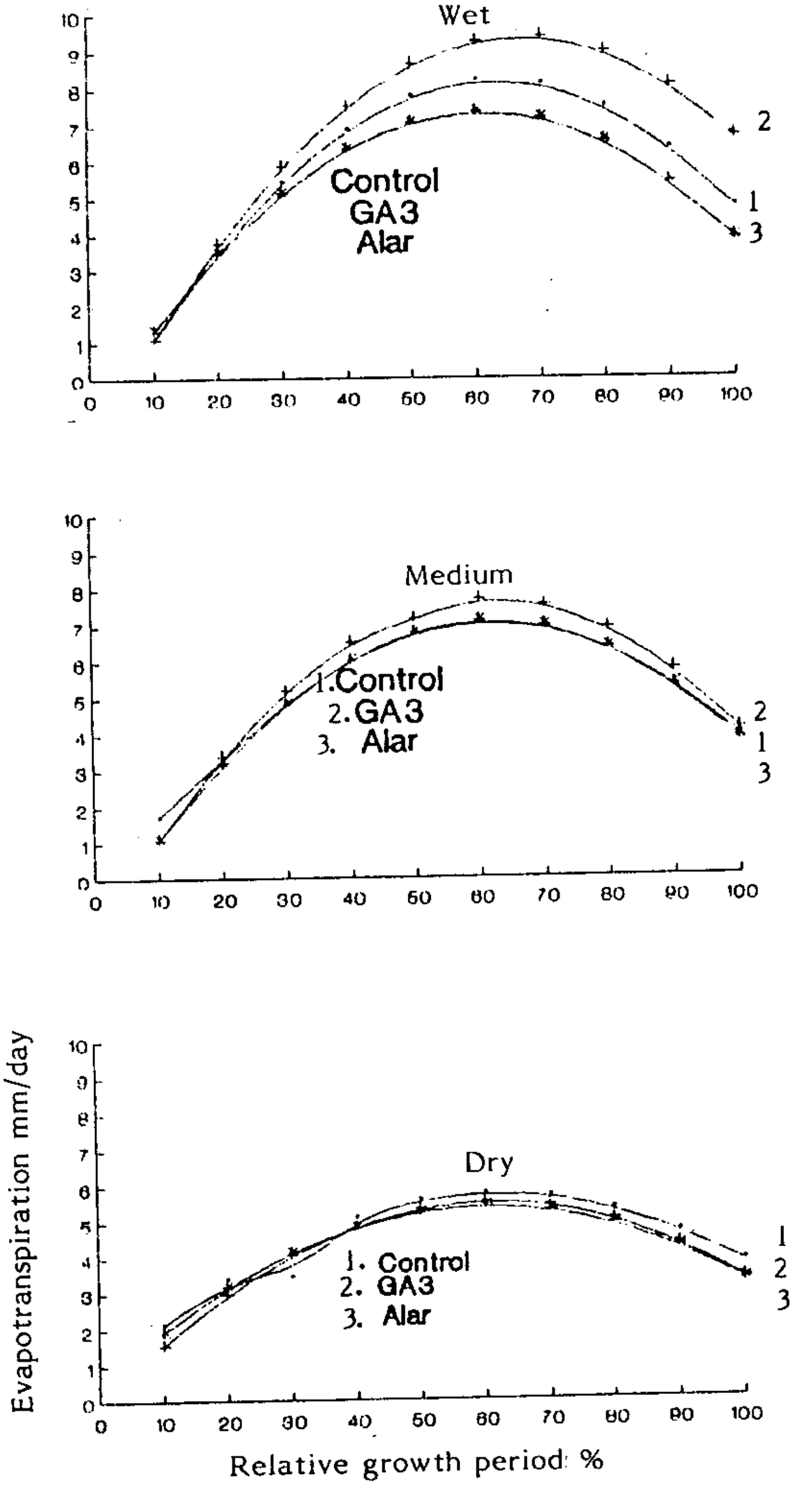

Fig. (2) : Daily evapotranspiration of soybean as related to relative growth period under different soil moisture level and growth substances.

4.3.3. Crop Coefficient : (K_c) :

The term crop coefficient has been developed to reflect the physiology of the crop and the degree of crop cover on potential evapotranspiration. For determining crop coefficient, both actual and potential evapotranspiration must be measured. Many workers showed that modified Penman method gave the most accurate values of potential evapotranspiration (Miseha, 1983; Abdel-Hamid et al., 1985 and Abbas, 1988).

Crop coefficient of soybean plant throughout its growth cycle under different treatments is presented in Table (20). The values were calculated according to the daily potential evapotranspiration estimated by Penman method and actual ET. derived from the wet treatment which produced the highest soybean yield. Crop coefficient (K_c) was very low at earlier stages of growth, then increased gradually as the percent of crop cover increased. The values of K_c exceeds the unit when soybean complete 70 to 80 % of its growth period. Thereafter, crop coefficient is decreased again when the plant started to mature. The lower K_c values during the early period of growth is mainly due to large diffusive resistance of bare soil. As the percent of crop cover increased the diffusive resistance decreased also, leaf area increased greatly through this period. When the crop started to mature, crop evapotranspiration decreased as the effective resistance to transpiration increased which resulted in lower K_c values in such periods. These results are in line with those reported by Burch et al. (1978) who concluded that the ratio of actual to potential evapotranspiration increased from 0.2 early in the season to about 1.2 at later

Table (20) : Crop coefficient (K_c) of soybean during its growth cycle as affected by some growth regulators.

Treatments		10	20	30	40	50	60	70	80	90	100
Potential mm./day	ET.*	10.14	9.87	9.42	9.97	9.13	8.59	8.33	8.07	7.50	7.31
Control											
Actual	ET**	2.13	2.86	4.52	6.58	8.03	8.33	8.58	8.07	6.38	4.17
	K_c	0.21	0.29	0.48	0.66	0.88	0.97	1.03	1.00	0.85	0.57
GA_3											
Actual	ET.	2.13	2.86	4.80	7.18	8.40	8.68	9.16	8.39	6.60	4.53
	K_c.	0.21	0.29	0.51	0.72	0.92	1.01	1.10	1.04	0.88	0.62
Alar											
Actual	ET.	2.13	2.76	4.42	6.18	7.67	7.73	7.75	6.13	4.95	4.09
	K_c	0.21	0.28	0.47	0.62	0.84	0.90	0.93	0.76	0.66	0.56

* Estimated by modified Penman method.

** Mean of two seasons.

stages for well watered plants. The above mentioned findings are in harmony with those reported by Doorenbos et al. (1979) and Abbas (1988).

With regard to the effect of growth substances on K_c values, results indicate that growth promoting substance (GA_3) increased such values. Such effect can be related to the effect of these compounds on the growth of plants and thereby on water consumption. The transpiring area (leaf area) increased by these chemicals and affect the loss of water by transpiration. These factors are responsible for the increase in K_c values compared with the control. On the contrary, the use of Alar (a growth retardant) caused a decline in the soybean crop coefficient. Such substance retard the growth of treated plants and increased the resistance to transpsiration and hence decreased K_c values after application. Thus, it can be concluded that the percent of crop cover and any modifications on the growth of plants either by promotion or retardation affect the crop coefficient. In this connection Miseha (1983) concluded that any environmental factor that affect the resistance to vapour diffusion may result in changes in crop coefficient either by increasing or decreasing such values. Changes in crop coefficient (K_c) may affect directly the evapotranspiration of a crop in concern.

4.4. Water Use Efficiency :

Water use efficiency has been used to evaluate various agronomic practices with respect to water consumption. Water use efficiency can be increased either by increasing crop production or by decreasing losses due to evapotranspiration. Crop production can be improved by the best choice of high yielding varieties, adaptation to the particular environment as well as by improvement of water management, air and nutrient supply to the roots and of light and CO_2 to the foliage.

4.4.1. Dry Matter Production :

Water use efficiency expressed as Kg. dry matter produced/one cubic meter of water consumed for soybean under the different treatments throughout its growth cycle is recorded in Table (21). Water use efficiency values were low at the first period of growth (from planting to 50 days) then reached a maximum through the period from (50 to 75 days after sowing). Such period is said to be the rapid vegetative growth period and flowering stage. Thereafter, water use efficiency values redecreased again (75 - 100 days) to reach a minimum at the end of the season i.e., from 100 to 130 days. These results may indicate the importance of adequate water supply through the period from 50 up to 75 days after sowing as water utilization shows its maximum rate.

The lower water use efficiency values in the first period can be ascribed to less vegetable crop cover through this period. In such period, the plants are small and intercept little of the net radiation, however, evaporation rate is very high from the exposed soil surface. Dry matter production was at a minimum compared with the losses of water by evapotranspiration process. These factors are responsible for lower water use efficiency values. The maximum values of water use efficiency observed in the second period can be explained

Table (21) : Water use efficiency by soybean (Kg. dry matter/m³ of water consumed) at various stages of growth as affected by soil moisture levels and some growth regulators.

Treatments	Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)							
	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$
		100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$	
Season 1988																								
From planting to 50 days	1.00	1.39	0.99	1.13	1.01	0.82	0.94	1.04	0.92	1.05	0.89	0.95	1.01	0.89	0.94	0.95	0.82	0.86	1.02	0.90	0.98	0.80	0.87	0.89
50 - 75 days	2.07	2.86	2.63	2.52	2.33	1.72	2.04	2.28	0.73	1.60	1.47	1.27	1.54	1.07	1.11	1.19	0.76	1.28	0.91	0.98	1.25	0.99	1.00	0.99
75 - 100 days	1.20	1.14	1.05	1.13	1.04	0.98	1.07	1.10	1.87	1.87	0.94	1.56	1.91	0.71	1.50	1.53	0.84	1.82	1.02	1.23	1.45	0.90	1.06	1.15
100-130 days	0.46	0.35	0.31	0.37	0.37	0.11	0.31	0.34	0.41	0.67	1.53	0.87	0.26	1.15	0.61	0.74	1.24	0.34	1.58	1.05	0.25	0.29	0.54	0.82
Season 1989																								
From planting to 50 days	1.10	1.18	0.87	1.05	0.89	0.91	0.97	1.01	1.04	1.01	1.0	1.02	1.06	0.91	1.00	1.01	0.73	1.08	0.92	0.91	1.02	0.85	0.87	0.89
50 - 75 days	2.03	3.35	2.27	2.55	2.02	2.31	2.12	2.34	1.45	2.41	1.60	1.82	1.99	1.26	1.57	1.70	0.69	1.82	1.52	1.34	1.66	1.10	1.15	1.25
75 - 100 days	1.33	2.40	2.00	1.91	1.40	2.35	1.69	1.80	1.41	1.50	2.03	1.65	1.16	1.19	1.25	1.45	1.01	1.42	1.12	1.18	1.42	1.10	1.18	1.18
100 - 130 days	0.35	0.28	0.23	0.29	0.29	0.27	0.30	0.30	1.37	0.35	0.30	0.67	0.41	0.83	0.87	0.77	0.94	1.15	1.84	1.31	1.85	2.02	1.60	1.46

on the basis that vegetative growth was at a maximum through such period. It is well known that light interception by plants increased by the increase in leaf area index. The growth and photosynthesis are proportional to the amount of net radiation intercepted by the canopy. On the other hand, evaporation is not proportional to leaf area index as it occures. from soil and plant surfaces. Therefore, dry matter production was higher in relation to water losses through transpiration and evaporation. All of these did result in increasing the values of water use effeciency.

The lower values of water use efficiency gained in the last period (100 - 130 days) is probably related to crop maturation.

In this respect, Ritchie and Burnett (1971) and Ritchie (1974) pointed out that water use efficiency is lower early in the season in most annual crops due to slow growth rates. They mentioned that large fraction of the evaporation flux is from soil surface compared with the amount from plant cover. They added that rapid growth rates per unit area of land would improve the efficiency of water use. The previous results are in full agreement with those reported by Miseha (1983) and Abbas (1988).

With regard to the effect of soil moisture levels on water use efficiency values, results recorded in Table (21) showed that under high soil moisture level, water use efficiency values were higher and decreased as soil moisture level decreased. In other words, increasing water deficit (prolonged irrigation intervals) did result in a sharp decrease in water use efficiency; such trend was found to be true in most of the growth periods of soybean plant. These results may prove the importance of maintaining soil moisture at a high level for maximum production of dry matter thereby higher water use efficiency values. On the contrary, severe water stress, reduced plant growth more than water consumption which resulted in lower water use efficiency values.

In this connection, Miseha (1983) concluded that plants subjected to severe water deficit are smaller than those subjected to moist or moderate water levels. Reduced cell turger is the most important reason for reduced plant size. Plant turgidity is important in relation to the opening and closing of stomata. Also, it is important for the expansion of leaves and movement of water and nutrients to various parts of the plant. The amount of turgidity may not directly influence the actual exchange of gases required in photosynthesis, but it will affect net photosynthesis indirectly through regulation of stomatal opening. All of these reduce dry matter ascumulation in plants subjected to severe moisture stress per unit of water consumed which resulted in lower water use efficiency values.

As for the effect of growth substances on water use efficiency by soybean at various growth stages data of Table (21) indicate that the use of GA_3 improved water use efficiency figures, with respect to control under high or medium soil moisture levels. However, under prolonged irrigation intervals, no clear trend was observed. In other words, the application of GA_3 did result in increasing water use efficiency values compared with the control. These findings indicate that the stimulation effect of GA_3 on dry matter production was found to be more than the increase in water consumption by such chemical. This phenomenon is the reason for increasing the values of water use efficiency. It is worthy to mention that the lower concentration of GA_3 was found to be more pronounced than the higher rate in improving water use efficiency by soybean plant. Such pattern can be ascribed to less dry matter produced under the higher concentration of GA_3. As for the role of Alar on water use efficiency reuslts gained from Table (21) showed that this chemical slightly decreased the values of water use efficiency compared with the control. Such findings can be ascribed to less dry matter production by plants treated with Alar. The higher the concentrations of applied Alar, the lower is the water use efficiency values.

In this respect, Miseha (1983) pointed out that growth of plants will be limited by lack of soil moisture thereby dry matter productivity. Thus the control of evapotranspiration by a crop must be considered in relation to the effect on photosynthesis or dry matter productivity. The use of growth promoting substances may increase dry matter production more than evapotranspiration resulting in our increase in water use efficiency. Such chemicals can improve the efficiency of water utilization expressed as dry matter produced per unit of water consumed under high moisture level but failed to cause any increase under lack of water.

4.4.2. Marketable Yield :

Table (22) represents the effect of growth regulators under

Table (22) : Water use efficiency by soybean expressed (Kg. seeds/m^3 water consumed) as affected by soil moisture levels and some growth regulators.

Treatments		Soil moisture levels				Soil moisture levels			
		Wet (85 % F.C.)	Medium (70 % F.C.)	Dry (55 % F.C.)	Main	Wet (85 % F.C.)	Medium (70 % F.C.)	Dry (55 % F.C.)	Mean
		Season 1988				**Season 1989**			
	Control	0.36	0.28	0.29	0.31	0.40	0.39	0.25	0.35
GA_3	100	0.37	0.36	0.30	0.34	0.53	0.39	0.41	0.44
(ppm)	200	0.37	0.33	0.30	0.33	0.39	0.38	0.40	0.39
	Mean	0.37	0.32	0.30	0.33	0.44	0.39	0.35	0.39
	Control	0.36	0.28	0.29	0.31	0.40	0.39	0.35	0.38
Alar	1000	0.37	0.36	0.31	0.35	0.38	0.35	0.37	0.37
(ppm)	2000	0.27	0.28	0.20	0.25	0.38	0.31	0.35	0.35
	Mean	0.33	0.31	0.27	0.30	0.39	0.35	0.36	0.37
Mean		0.35	0.32	0.29	0.32	0.42	0.37	0.36	0.38

three moisture levels on water use efficiency expressed as Kg of seeds/ m^3 of water consumed in complete evapotranspiration. Soil moisture levels induced a great response on water use efficiency by soybean. The highest water use efficiency values were scored from the wet soil moisture level (irrigated at 85 % F.C.) followed by the medium level, whereas the least values were produced from the dry one (prolonged irrigation intervals). These results indicate that the relative decrease in soybean yield by increasing soil moisture stress was much more than the decrease in seasonal evapotranspiration. Such pattern of results may prove the importance of water for higher yield production thereby more efficient use of water by soybean. Thus, maintaining soil water at a high level not only increase crop production but also allows the plants to use water more efficiently. In other words, increasing water deficit did result in decreasing crop yield and in the same time affects greatly water utilization. These results are in full agreement with those reported by Abbas (1988) who pointed out that water use efficieny values decreased by increasing soil moisture stress.

As for the effect of growth substances on water use efficiency, results indicate that growth promoting substance i.e. GA_3 improved such values. In other words, the use of GA_3 did result in increasing water use efficiency by soybean. The low rate of GA_3 was found to be more pronounced in this respect. Such findings mean that the increase in seed yield by GA_3 was found to be greater than the enchancing effect on evapotranspiration. All of these are the main reasons of increasing water use efficiency values by such chemical. In this respect

Tinus (1974) concluded that water use efficiency improved by optimizing the factors that promote growth. The above mentioned results are in full agreement with those reported by Miseha (1983).

Concerning the role of growth retardant (Alar) on water use efficiency, results indicate that such chemicals seemed to decrease the efficiency of water utilization. These results reveal that the decrease in crop production by the use of retardant is some what more than the reduction in evapotranspiration. It is worthy to mention that the higher rate of Alar decreased the values of water use efficiency than the lower one. This means that the higher the rate of Alar used, the lower are the values of water use efficiency. Such reduction in water use efficiency was found to be clear under high soil moisture stress than wet conditions. In this connection, Miseha, (1983) pointed out that Alar application did not cause any appreciable increase in water use efficiency values.

4.5. Water and Soybean Yield Relationship :

It has been mentioned previously that soil moisture levels comprise the main constrain in soybean production. Thus, for better understanding such problem, it thought advisable to find out the relationship between water and yield. In other words, at what moisture status should irrigation be applied in order to obtain the maximum yield ? or what should be the loss in soybean yield if water application is inadequate ? Chang (1971) concluded that when the actual evapotranspiration falls short of the potential, the actual yield will also be less than the maximum. However, the relationship between evapotranspiration and yield in the field may or may not be linear as it is between transpiration and dry matter production in container experiments. This is partly because the fraction of evaporation that does not contribute to plant growth varies throughout the crop cycle.

4.5.1. Actual evapotranspiration and soybean yield :

The results of the two seasons have been analyzed by plotting the yield of soybean againest the water consumption. The best description of the relation was found to be the linear function in the form :

$$y = a + b\,x$$

where : y = soybean yield (seed yield, straw yield, biological yield and oil production) in kg. feddan.

x = actual evapotranspiration in cm.

a. Seed yield (y_1)

$\hat{y}_1 = 394.8 + 20.76$

Relative contribution

(R.C.) = 71.44

b. Straw yield (y_2)

$\hat{y}_2 = -1211 + 53.67\,x$

R.C. = 75.69

c. Biological yield ($\hat{y}_3$)

$\hat{y}_3 = -1606 + 74.43\,x$

R.C. = 75.74

d. Oil production ($\hat{y}_4$)

$\hat{y}_4 = -132.7 + 5.185\,x$

R.C. = 73.05

Such relations were statistically significant and demonstrate that actual evapotranspiration affected greatly the productivity of soybean crop.

4.5.2. Soil moisture level and yield :

Data of soybean yield had been plotted against the level of soil moisture when irrigation water was applied. Statistical analysis showed that the degree of this relation was a first class function or linear relationship in the form :

$$y = a + b\,x$$

where :

y = Soybean yield (seed yield, straw yield, biological yield and oil production) in Kg./fed.

x = the level of soil moisture when irrigation water is applied as a percnt from field capacity.

a. Seed yield ($\hat{y}_1$)

$$\hat{y}_1 = -181.7 + 1693\,x$$

Relative contribution (R.C.) = 59.53%

b. Straw yield ($\hat{y}_2$)

$$\hat{y}_2 = -614.4 + 4309\,x$$

R.C. = 61.19 %

c. Biological yield ($\hat{y}_3$)

$$\hat{y}_3 = -796.1 + 6002\,x$$

R.C. = 61.76 %

d. Oil production ($\hat{y}_4$)

$$\hat{y}_4 = -80.8 + 424.6\ x$$

R.C. = 61.44 %

The previous relationships were found to be significant. Such results may prove the importance of available soil water in the production of soybean crop.

4.5.3. Actual evapotranspiration, soil moisture level and yield:

It seems advisable to develop the relation between the two factors i.e. actual evapotrainspiration and soil moisture level and soybean yield. Such relationship explain that both factors affect the productivity of soybean crop. These relations have the form :

$$y = a + bx_1 + cx_2$$

where :

y = Soybean yield (seed, straw, biological and oil yield) in kg./feddan

x_1 = Soil moisture level when irrigation water was applied as a percent from field capacity.

x_2 = Actual evapotranspiration in cm.

a. Seed yield

$$\hat{y}_1 = -397.4 - 379.7\ x_1 + 24.75\ x_2$$

Relative contribution (R.C.) = 71.8

b. Straw yield

$$\hat{y}_2 = -1222 - 1527\ x_1 + 69.7\ x_2$$

R.C. = 76.62

c. **Biological yield ($\hat{y}_3$)**

$$\hat{y}_3 = -1619 - 1906\,x_1 + 94.45\,x_2$$

R.C. = 76.49

d. **Oil production ($\hat{y}_4$)**

$$\hat{y}_4 = -133.2 - 78.78\,x_1 + 6.013\,x_2$$

R.C. = 73.3

The previous relations showed that the amount of water consumed in complete evapotranspiration by soybean plant or seasonal water consumption is the main factor determining the crop yields. Such finding may indicate that any environmental factor affecting seasonal water consumption by soybean crop had a great response on its production.

4.6. Chemical Composition :

4.6.1. Soybean Protein :

The nutritive value of ed ible seeds such as soybean is determined by their content of protein. Protein connectedof soybean seeds is an important factor affecting its quality. The nutritive value of the protein is conected with its solubility in the different known solvents. The amount and quality of protein in seeds may be influenced by soil moisture levels and growth regulators.

Protein fractions of the defatted soybean seeds were extracted as water soluble (albumins like protein); salt soluble (5% NaCl, glubulins like protein); ethanol soluble (prolamins like protein), borate biffer soluble (glublins like protein) and residual insoluble protein and calculated on dry basis. Such results are presented in Table (23).

Table (23) : Effect of soil moisture levels and some growth regulators on protein fractions of soybean seeds (mg./g.).

Treatments	Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)							
	Control	GA$_3$ (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA$_3$ (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA$_3$ (ppm)			Alar (ppm)			Irrig. $\bar{X}$
Fractions		100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$	
												Season 1988												
F_1	105.2	•99.9	74.0	93.0	108.4	99.9	104.5	98.8	107.7	113.8	76.9	99.5	107.7	100.6	105.3	102.4	115.1	120.0	85.4	106.8	93.7	75.0	94.6	100.7
F_2	18.0	18.2	17.6	17.9	18.2	23.5	19.9	18.9	18.5	19.4	17.8	18.6	18.5	17.8	18.3	18.5	25.2	25.0	24.4	24.9	25.0	21.9	24.0	24.5
F_3	9.0	12.1	11.8	11.0	9.1	11.8	10.0	10.5	9.2	19.2	13.8	14.1	9.2	11.8	10.1	12.1	12.6	28.1	18.3	19.7	18.8	25.0	18.8	19.3
F_4	36.1	18.5	25.2	26.6	51.5	43.5	43.7	35.2	43.1	30.8	32.6	35.5	36.9	35.5	38.5	37.0	64.7	31.3	33.6	43.2	43.8	38.1	48.9	46.1
F_5	78.6	77.7	77.0	77.8	62.9	136.4	92.6	85.2	108.5	85.8	80.9	91.7	54.1	156.8	106.5	99.1	123.8	86.2	92.1	100.7	58.2	157.0	113.0	106.9
Total	246.9	226.4	205.6	226.3	250.1	315.1	270.7	248.5	287.0	269.0	222.0	259.3	226.4	322.5	278.7	269.0	341.4	290.6	253.8	295.3	239.5	317.0	299.3	297.3
												Season 1989												
F_1	99.2	87.8	93.1	93.4	86.5	78.1	87.9	90.7	103.8	104.6	106.0	104.8	95.6	90.8	96.4	100.6	112.3	121.0	86.1	106.5	110.7	103.8	108.9	107.7
F_2	21.0	18.2	24.0	21.1	20.7	20.3	20.7	20.9	24.4	30.8	30.7	28.6	36.6	18.2	26.4	27.5	24.6	18.6	21.5	21.6	24.6	24.4	24.5	23.1
F_3	13.0	10.2	15.0	12.7	11.7	20.3	15.0	13.9	15.3	12.3	12.2	12.2	13.3	12.2	12.1	13.2	13.3	12.4	15.4	13.4	12.3	15.3	13.3	13.4
F_4	30.1	33.3	30.1	31.2	17.8	17.4	21.8	26.5	36.6	43.1	30.6	36.8	24.4	42.4	34.5	35.7	46.1	37.2	30.8	38.0	36.9	46.6	43.2	40.6
F_5	100.3	72.1	80.9	84.4	47.6	99.0	82.3	83.4	101.9	81.2	90.1	91.1	48.5	77.8	76.1	83.6	101.0	104.0	114.3	106.4	83.6	116.9	100.5	103.5
Total	263.6	221.6	243.1	242.8	184.3	235.1	227.7	235.3	282.0	272.0	269.6	274.6	216.3	241.3	246.5	260.6	296.3	293.2	268.1	285.9	268.1	307.0	290.4	288.3

Results showed that the concentration of water soluble and residual non-soluble protein were higher fractions followed by borate buffer soluble protein. Those fractions comprise about 85 % of the total protein. However, the least fractions were found to be ethanol soluble and salt soluble protein. These results may indicate that about 40 % of total amount of soybean protein is said to be non soluble.

As for the effect of soil moisture levels on protein fractions, results showed that the increase in total amount of protein by water deficit (prolonged irrigation intervals is restricted mainly through residual non soluble protein and borate biffer soluble protein. However, other fractions changed slightly to a less extent.

Regarding the effect of growth regulators, data of table (23) showed that GA_3 seemed to reduce the total amount of protein fractions. The most pronounced reduction was found to be in residual non soluble protein. As for the effect of Alar, it can be concluded that such retardent seemed to increase the total amount of protein. Such increase was found to be in the most protein fractions especially the non soluble protein. This type of results may show that growth regulators play a role in nitrogen metabolism.

In this conection, Thomas <u>et al.</u> (1973) concluded that specific biosynthesis of protein in the developing seeds may take place in two ways a) by condensation of amino acids translocated from green leaves to else where or b) by reaction in which carbohydrate, amids and amonium salts may part cipate. Also, Abdel-Hamid <u>et al.</u> (1981) pointed out that growth promoters such as GA_3 and auxins seemed to control protein metabolism.

4.6.2. Nitrogen, Phosphorus and Potassium Content :

Results of total nitrogen, phosphorus and potassium contents in different soybean plant organs throughout its growth cycle as well as the relative increase under the different treatments are presented in Tables (27 - 29). Also the distribution of the above mentioned nutrients in different plant organs with respect to the total amount in recorded in table (27-29). The percent of N P K in the whole soybean plant throughout its growth cycle is presented in Table (30).

Nitrogen, phosphorus and potassium content of the various soybean parts increased gradually by advancing age up to the last sample. These results mean that the apsorption of such nutrients contined up to lat er periods of its growth. Moreover, leaves of soybean always possesed the higher amounts of N P K during the first and second periods of growth. However, stem was found to be in the second rank in this respect, while root contains the least amount of these nutrients. At lat er periods of growth pods possesed the highest macro-nutrients followed by the leaves and stem, while the lowest amount was found to be within roots. These results may lead to the conclusion that the translocation of these elements continued to the last period of growth.

Regarding the effect of soil moisture level on the N P K content, results indicate that the total amount of the tested nutrients were influenced by irrigation treatments. The accumulation of such elements in the various plant organs was decreased by increasing soil moisture stress. These type of results may prove that the level of soil moisture affects the absorption of plant nutrients thereby the growth of soybean. In addition, the availabilty of different nutrients in soil

Table (24) : Effect of soil moisture levels and some growth regulators on nitrogen content at different periods of soybean growth (mg N/plant).

Treatments			50 days					75 days						100 days						% increase		
			Root	Stem	L.P.	L.B.	W.P.	Root	Stem	L.P.	L.B.	Pods	W.P.	Root	Stem	L.P.	L.B.	Pods	W.P.	50	75	100
Wet (85 % F.C.)		0	6	31	14	228	279	10	91	37	251	189	578	18	163	52	310	387	930	30.0	62.2	100
	GA_3	100	9	41	15	221	286	14	216	54	334	265	883	13	303	76	364	556	1312	21.8	67.3	100
		200	7	41	15	201	264	11	167	64	220	251	713	11	119	71	304	510	1015	26.0	70.2	100
		$\bar{X}$	7	38	15	217	277	12	158	52	268	235	725	14	195	66	326	484	1085	25.5	66.8	100
	Alar	1000	6	22	13	195	236	13	108	37	214	181	553	14	156	41	291	447	949	24.9	58.3	100
		2000	7	20	17	157	201	11	71	43	216	108	449	13	173	37	286	396	905	22.2	49.6	100
		$\bar{X}$	6	24	15	193	238	11	40	39	227	159	476	15	164	43	296	410	928	25.6	51.3	100
	$\bar{X}$		7	31	15	205	258	12	124	46	248	197	627	15	180	55	311	447	1008	25.6	62.2	100
Medium (70 % F.C.)		0	5	24	11	134	174	10	74	26	162	57	329	9	59	27	193	238	526	33.1	62.5	100
	GA_3	100	4	28	13	143	188	8	111	35	221	176	551	11	106	49	235	580	981	19.2	56.2	100
		200	6	41	16	145	208	7	125	21	156	94	403	8	153	18	164	400	748	27.8	53.9	100
		$\bar{X}$	5	31	13	141	190	8	103	27	180	109	427	9	108	31	197	406	751	25.3	56.9	100
	Alar	1000	7	30	15	139	191	9	100	36	222	123	490	10	74	31	199	355	669	28.6	73.2	100
		2000	7	29	16	108	160	10	56	25	165	82	338	13	51	18	114	276	472	33.9	71.6	100
		$\bar{X}$	6	28	14	127	175	10	77	29	183	37	386	11	61	25	169	290	556	31.5	69.4	100
	$\bar{X}$		6	30	14	134	184	9	90	28	182	98	407	10	85	28	183	348	654	28.1	62.2	100
Dry (55 % F.C.)		0	5	28	9	111	153	7	40	14	108	24	193	6	66	18	101	217	408	37.5	47.3	100
	GA_3	100	8	31	16	125	180	7	80	24	129	47	287	7	112	22	166	281	588	30.6	48.8	100
		200	5	24	10	111	150	8	86	18	154	31	297	10	63	22	123	156	374	40.1	79.4	100
		$\bar{X}$	6	28	12	116	162	7	69	19	130	34	259	8	80	21	130	218	457	35.4	56.7	100
	Alar	1000	5	40	13	121	179	10	62	18	164	38	282	8	72	26	156	240	502	35.7	56.2	100
		2000	10	35	10	95	150	12	51	13	136	29	241	10	48	20	110	175	363	41.3	66.4	100
		$\bar{X}$	7	34	11	109	161	10	51	15	136	30	242	8	62	21	122	211	424	38.0	56.2	100
	$\bar{X}$		7	31	12	113	163	9	60	17	133	32	251	8	71	21	126	215	441	41.3	66.4	100

Table (25) : Effect of soil moisture levels and some growth regulators on phosphorus content at different periods of soybean gowth (mg p./plant).

Treatments			50 days					75 days						100 days						% increase		
			Root	Stem	L.P.	L.B.	W.P.	Root	Stem	L.P.	L.B.	Pods	W.P.	Root	Stem	L.P.	L.B.	Pods	W.P.	50	75	100
Wet (85 % F.C.)		0	0.9	6.5	1.8	6.2	15.4	1.8	24.1	8.0	8.7	30.0	72.6	3.1	37.7	11.8	15.5	45.4	113.5	13.6	64.0	100
	GA_3	100	1.0	5.0	0.7	9.6	16.3	1.2	37.6	5.2	15.1	37.5	96.6	1.3	33.2	3.2	20.9	63.6	122.2	13.3	79.1	100
		200	1.4	4.3	1.8	16.8	24.3	0.9	31.6	4.4	5.6	27.3	69.8	1.1	50.5	11.6	10.0	58.2	131.4	18.5	53.1	100
		X̄	1.1	5.3	1.4	10.9	18.7	1.3	31.1	5.9	9.8	31.6	79.7	1.8	40.5	8.9	15.5	55.7	122.4	15.3	65.1	100
	Alar	1000	2.0	8.3	0.6	7.4	18.3	1.6	27.0	3.9	8.4	28.4	69.3	1.2	33.6	6.4	6.2	52.5	99.9	18.3	69.4	100
		2000	1.0	6.0	2.2	8.8	18.0	1.2	19.0	6.2	5.0	14.9	46.3	1.1	24.8	4.6	4.9	48.0	83.4	21.6	55.5	100
		X̄	1.3	6.9	1.5	7.5	17.2	1.5	23.4	6.0	7.4	24.4	62.7	1.8	32.0	7.6	8.9	48.6	98.9	17.4	63.4	100
	X̄		1.2	6.1	1.5	9.2	18.0	1.4	27.3	6.0	8.6	28.0	71.3	1.8	36.3	8.3	12.2	52.2	110.8	16.2	64.4	100
Medium (70 % F.C.)		0	1.7	8.2	1.6	3.8	15.3	1.0	20.5	1.0	2.3	10.0	34.8	3.2	16.7	1.7	2.3	32.9	56.8	26.9	61.3	100
	GA_3	100	1.1	4.3	0.6	8.0	14.0	0.8	22.1	1.9	10.3	12.8	47.9	1.1	5.7	2.6	11.5	47.5	68.4	20.5	70.0	100
		200	1.0	3.9	1.5	10.4	16.8	0.7	18.5	2.0	5.9	11.5	38.6	0.8	47.5	7.4	6.6	48.7	111.0	15.1	34.8	100
		X̄	1.3	5.4	1.2	7.4	15.3	0.8	20.4	1.6	6.2	11.4	40.4	1.7	23.3	3.9	6.8	43.0	78.7	19.4	51.3	100
	Alar	1000	2.4	3.7	1.4	6.7	14.2	1.9	13.6	3.3	2.9	19.4	41.1	1.0	14.3	4.5	3.1	37.6	60.5	23.5	80.1	100
		2000	1.7	6.3	1.7	4.6	14.3	2.4	15.8	3.6	5.8	8.8	36.4	1.4	13.0	3.5	1.4	22.3	41.6	34.4	87.5	100
		X̄	1.9	6.1	1.6	5.0	14.6	1.8	16.6	2.6	3.7	12.7	37.4	1.9	14.7	3.2	2.3	30.9	53.0	27.5	70.6	100
	X̄		1.6	5.8	1.4	6.2	15.0	1.3	18.5	2.1	5.0	12.1	39.0	1.8	19.0	3.6	4.6	37.0	66.0	22.7	59.1	100
Dry (55 % F.C.)		0	1.7	1.5	0.9	3.9	8.0	3.4	4.9	0.6	4.9	2.0	15.8	2.0	5.4	0.8	2.6	15.2	26.0	30.8	60.8	100
	GA_3	100	1.3	3.5	0.8	10.3	15.9	1.1	13.2	2.7	5.4	4.6	27.0	0.8	9.2	4.0	1.0	21.8	36.8	43.2	73.4	100
		200	1.1	4.3	1.2	5.2	11.8	1.9	12.9	3.9	4.3	1.8	24.8	1.3	14.6	4.5	2.6	20.0	43.0	27.4	57.7	100
		X̄	1.4	3.1	1.0	6.5	12.0	2.1	10.3	2.4	4.9	2.8	22.5	1.4	9.7	3.1	2.1	19.0	35.3	24.0	63.7	100
	Alar	1000	1.0	7.3	2.2	5.5	16.0	1.8	13.1	3.8	7.4	5.8	31.9	0.8	16.3	2.5	8.7	24.4	52.7	30.4	60.5	100
		2000	1.7	3.1	1.0	6.8	12.6	2.1	15.6	1.8	1.7	4.3	25.5	0.9	9.5	3.8	0.6	21.4	36.2	34.8	70.4	100
		X̄	1.5	4.0	1.4	5.4	12.3	2.4	11.2	2.1	4.7	4.0	24.4	1.2	10.4	2.4	4.0	20.3	38.3	32.1	63.7	100
	X̄		1.5	3.6	1.2	6.0	12.3	2.3	10.8	2.3	4.8	4.4	24.6	1.3	10.1	2.8	3.1	19.7	37.0	33.2	66.5	100

Table (26) : Effect of soil moisture levels and some growth regulators on potassium content at different periods of soybean growth (mg K/plant).

Soil moisture	Treatments		50 days Root	Stem	L.P.	L.B.	W.P.	75 days Root	Stem	L.P.	L.B.	Pods	W.P.	100 days Root	Stem	L.P.	L.B.	Pods.	W.P.	% increase 50	75	100
Wet (85 % F.C.)		0	19	87	51	107	264	31	223	124	133	295	806	30	261	165	227	364	1047	25.2	77.0	100
	GA_3	100	20	75	60	123	278	47	342	252	183	312	1136	38	335	241	204	5342	1372	20.3	82.8	100
		200	17	87	46	107	257	28	283	200	140	305	956	28	344	242	230	441	1285	20.0	74.4	100
		$\bar{X}$	19	83	52	112	266	35	283	192	152	304	966	32	313	216	220	453	1234	21.6	78.3	100
	Alar	1000	22	96	56	102	276	32	251	171	149	249	852	34	336	147	149	3821	1048	26.3	81.3	100
		2000	18	65	51	100	234	32	177	137	137	147	630	29	285	154	187	328	983	23.8	64.1	100
		$\bar{X}$	20	83	53	103	259	32	217	144	140	230	763	31	294	155	188	358	1026	25.2	74.4	100
	$\bar{X}$		20	83	53	108	264	34	250	168	146	267	865	32	304	186	204	406	1132	30.5	76.4	100
Medium (70 % F.C.)		0	23	65	44	150	282	27	162	97	98	87	471	22	122	90	125	210	569	49.6	82.8	100
	GA_3	100	19	55	53	95	222	29	272	124	133	180	738	24	189	109	143	480	945	23.5	78.1	100
		200	15	72	40	73	200	29	211	90	95	112	537	18	241	85	91	397	832	24.0	64.5	100
		$\bar{X}$	19	64	46	106	235	28	215	104	109	126	582	21	184	95	120	362	782	30.1	74.4	100
	Alar	1000	16	74	43	81	214	27	236	114	122	144	643	27	236	127	106	310	806	26.6	79.8	100
		2000	17	68	39	128	252	25	133	81	82	90	411	22	163	71	66	246	568	44.4	72.4	100
		$\bar{X}$	19	69	42	120	250	26	177	97	101	107	508	24	174	96	99	255	648	38.6	76.4	100
	$\bar{X}$		19	67	44	113	243	27	196	101	105	117	546	23	179	96	110	309	717	33.9	76.2	100
Dry (55 % F.C.)		0	12	50	30	56	148	17	70	60	69	35	251	12	89	63	71	179	414	35.7	47.4	100
	GA_3	100	23	53	36	78	190	26	175	79	107	67	454	19	122	80	83	225	529	35.9	85.8	100
		200	17	49	30	56	152	20	138	73	81	38	350	26	89	74	78	149	416	36.5	84.1	100
		$\bar{X}$	17	51	32	63	163	21	128	71	86	47	353	19	100	72	77	184	452	36.1	78.1	100
	Alar	1000	15	64	33	67	179	26	140	70	89	65	390	21	119	86	98	152	476	37.6	81.9	100
		2000	16	53	25	107	201	22	102	49	72	38	283	17	98	60	78	148	401	50.1	70.6	100
		$\bar{X}$	14	56	29	77	176	22	104	60	77	46	309	17	102	70	82	160	431	40.8	71.7	100
	$\bar{X}$		16	54	31	70	171	22	116	66	82	47	333	18	101	71	80	172	442	38.7	75.3	100

Table (27) : Effect of soil moisture levels and some growth regulators on nitrogen distribution at different periods of soybean growth.

Treatment			50 days				75 days					100 days				
			Root	Stem	L.P.	L.B.	Root	Stem	L.P.	L.B.	Pods	Root	Stem	L.P.	L.B.	Pods
Wet (85 % F.C.)		0	2	11	5	82	1	16	6	43	34	2	18	6	33	41
	GA_3	100	3	14	5	78	2	24	6	38	30	1	23	6	28	42
		200	3	16	6	75	2	23	9	31	35	1	12	7	30	50
		$\bar{X}$	3	14	5	78	2	21	7	37	33	1	18	6	30	45
	Alar	1000	3	9	6	82	2	20	7	39	32	1	16	4	32	47
		2000	3	10	8	79	3	16	10	47	24	1	19	4	32	44
		$\bar{X}$	3	10	6	81	2	17	8	43	30	2	17	5	32	44
	$\bar{X}$		3	12	6	79	2	20	7	40	31	2	18	5	31	44
Medium (70 % F.C.)		0	3	14	6	77	3	23	8	49	17	1	12	5	37	45
	GA_3	100	2	15	7	76	2	20	6	40	32	1	11	5	24	59
		200	3	20	8	69	2	31	5	39	23	1	22	2	22	54
		$\bar{X}$	3	16	7	74	2	25	6	43	24	1	14	4	26	55
	Alar	1000	4	16	8	72	2	20	7	45	26	2	10	5	30	53
		2000	4	18	10	68	3	17	7	49	24	3	11	4	24	58
		$\bar{X}$	3	17	8	72	3	20	8	47	22	2	11	5	30	52
	$\bar{X}$		3	16	8	73	2	22	6	47	23	2	13	4	28	53
Dry (55 % F.C.)		0	3	18	6	73	4	21	7	56	12	2	16	4	25	53
	GA_3	100	4	17	9	70	2	28	8	45	17	1	19	4	28	48
		200	3	16	7	74	3	29	6	52	10	3	17	6	33	41
		$\bar{X}$	4	17	7	72	3	26	7	51	13	2	18	5	28	47
	Alar	1000	3	22	7	68	4	21	5	57	13	2	14	5	31	48
		2000	7	23	7	63	5	22	5	56	12	3	13	6	30	48
		$\bar{X}$	4	21	7	68	4	22	6	56	12	2	15	5	29	49
	$\bar{X}$		4	19	7	70	4	24	7	53	12	2	16	5	29	48

Table (28) : Effect of soil moisture levels and some growth regulators on phosphours distribution at different periods of soybean growth.

Treatment			50 days				75 days					100 days				
			Root	Stem	L.P.	L.B.	Root	Stem	L.P.	L.B.	Pods	Root	Stem	L.P.	L.B.	Pods
Wet (85 % F.C.)		0	6	42	12	40	2	33	11	12	42	3	33	10	14	40
	GA_3	100	6	31	4	59	1	39	5	16	39	1	27	3	17	52
		200	6	18	7	69	1	45	6	8	40	1	38	9	8	44
		$\bar{X}$	6	30	8	56	2	39	7	12	40	1	33	7	13	46
	Alar	1000	11	45	3	41	2	39	6	12	41	1	34	6	6	53
		2000	6	33	12	49	3	41	13	11	32	1	30	6	6	57
		$\bar{X}$	8	40	9	43	2	37	10	12	39	2	32	8	9	49
	$\bar{X}$		7	34	8	51	2	38	8	12	40	2	33	7	11	47
Medium (70 % F.C.)		0	11	54	10	25	3	59	3	7	28	6	29	3	4	58
	GA_3	100	8	31	4	57	2	46	4	22	26	2	8	4	17	69
		200	6	23	9	62	2	48	5	15	30	1	43	7	6	43
		$\bar{X}$	8	35	8	49	2	50	4	15	29	2	30	5	9	54
	Alar	1000	17	26	10	47	5	33	8	7	47	2	24	7	5	62
		2000	12	44	12	32	7	43	10	16	24	3	31	8	3	55
		$\bar{X}$	13	43	11	33	5	44	7	10	34	4	28	6	4	58
	$\bar{X}$		11	39	9	41	3	47	5	13	32	3	29	5	7	56
Dry (55 % F.C.)		0	21	19	11	49	22	31	4	31	12	2	25	11	3	59
	GA_3	100	8	22	5	65	4	49	10	20	17	2	25	11	3	59
		200	9	36	10	45	8	52	16	17	7	3	34	10	6	47
		$\bar{X}$	12	26	8	54	9	46	11	22	12	4	27	9	6	54
	Alar	1000	6	46	14	34	6	41	12	23	18	2	31	5	17	45
		2000	13	25	8	54	8	61	7	7	17	2	26	10	2	60
		$\bar{X}$	12	33	11	44	10	46	9	19	16	2	27	9	7	55
	$\bar{X}$		12	29	10	49	9	44	9	20	18	3	27	9	7	54

Table (29) : Effect of soil moisture levels and some growth regulators on potassium distribution at different periods of soybean growth.

Moisture	Treatment		50 days				75 days					100 days				
			Root	Stem	L.P.	L.B.	Root	Stem	L.P.	L.B.	Pods	Root	Stem	L.P.	L.B.	Pods
Wet (85 % F.C.)	0		7	33	19	41	4	28	15	17	36	3	25	16	22	34
	GA_3	100	7	27	22	44	4	30	22	16	28	3	24	18	15	40
		200	7	34	18	41	3	30	21	15	31	2	27	19	18	34
		$\bar{X}$	7	31	20	42	4	29	20	16	31	3	25	18	18	36
	Alar	1000	8	35	20	37	4	29	20	17	30	3	32	14	14	37
		2000	8	28	22	42	5	28	22	22	23	3	29	16	19	33
		$\bar{X}$	8	32	20	40	4	28	19	18	31	3	29	15	18	35
	$\bar{X}$		8	31	20	41	4	29	19	17	31	3	27	16	18	36
Medium (70 % F.C.)	0		8	23	16	53	6	34	20	21	19	4	21	16	22	37
	GA_3	100	9	25	24	42	4	37	17	18	24	3	20	12	15	50
		200	8	36	20	36	5	39	17	18	21	2	29	10	11	48
		$\bar{X}$	8	27	20	45	5	37	18	19	22	3	24	12	15	46
	Alar	1000	7	35	20	38	4	37	18	19	22	3	29	16	13	39
		2000	7	27	15	51	6	32	20	20	22	4	29	13	12	42
		$\bar{X}$	8	28	17	47	5	35	19	20	21	4	27	15	15	39
	$\bar{X}$		8	28	18	46	5	36	18	19	22	3	25	13	15	44
Dry (55 % F.C.)	0		8	34	20	38	7	28	24	27	14	3	21	15	17	44
	GA_3	100	12	28	19	41	6	39	17	24	14	4	23	15	16	42
		200	11	32	20	37	6	39	21	23	11	6	21	18	19	36
		$\bar{X}$	10	31	20	39	6	36	20	24	14	4	22	16	17	41
	Alar	1000	8	36	18	38	7	36	18	23	16	4	25	18	21	32
		2000	8	26	12	54	8	36	17	25	14	4	24	15	19	38
		$\bar{X}$	8	32	16	44	7	34	19	25	15	4	24	16	19	37
	$\bar{X}$		9	32	18	41	7	35	20	25	13	4	23	16	18	39

Table (30) : The relationships between N, P and K content of whole soybean plant through out the different stages of growth.

Treatments			50 days							75 days							100 days						
			mg./plant				% of total amount			mg./plant				% of total amount			mg./plant				% of total amount		
			N.	P.	K.	Total	N.	P.	K.	N.	P.	K.	Total	N.	P.	K.	N.	P.	K.	Total	N.	P.	K.
Wet (85 % F.C.)		0	279	15.4	264	558	50	3	47	578	72.6	806	1457	40	5	55	930	114	1047	2091	45	5	50
	GA_3	100	286	16.3	278	580	49	3	48	883	96.6	1136	2116	42	5	53	1312	122	1372	2806	47	4	49
		200	264	24.3	257	545	48	4	48	713	69.8	956	1739	41	4	55	1015	131	1285	2431	42	5	53
		$\bar{X}$	276	18.7	266	561	49	3	48	725	79.9	966	1771	41	5	54	1086	122	1235	2443	44	5	51
	Alar	1000	236	18.3	276	530	45	3	52	553	69.3	852	1474	38	5	57	949	100	1048	2097	45	5	51
		2000	201	18.0	234	453	44	4	52	449	46.3	630	1125	40	4	56	905	83	983	1971	46	4	50
		$\bar{X}$	239	17.2	258	514	46	3	51	527	62.7	763	1352	39	5	56	928	99	1026	2053	45	5	50
	$\bar{X}$		258	18.0	262	538	48	3	49	626	71.2	865	1562	40	5	55	1007	111	1131	2248	45	5	50
Medium (70 % F.C.)		0	174	15.3	282	471	37	3	60	329	34.8	471	835	39	4	57	526	57	569	1152	46	5	49
	GA_3	100	188	140	222	424	44	3	53	551	47.9	738	1337	41	4	55	981	68	945	1994	49	3	48
		200	208	16.8	200	425	49	4	47	403	38.6	537	979	41	4	55	748	111	832	1691	44	7	49
		$\bar{X}$	190	15.4	235	440	43	4	53	428	40.4	582	1050	41	4	55	752	79	782	1612	47	5	48
	Alar	1000	191	14.2	214	419	46	3	51	490	41.1	643	1174	42	4	54	669	61	806	1536	44	4	52
		2000	160	14.3	252	426	38	3	59	338	36.4	411	785	43	5	52	472	42	568	1082	44	4	52
		$\bar{X}$	175	14.6	249	439	40	3	57	386	37.4	508	931	41	4	55	556	53	648	1257	44	4	52
	$\bar{X}$		183	15.0	242	440	42	3	55	407	38.9	545	991	41	4	55	654	66	715	1435	46	5	49
Dry (55 % F.C.)		0	153	8.0	148	309	50	3	47	193	15.8	251	460	42	3	55	408	26	414	848	48	3	49
	GA_3	100	180	15.9	190	386	47	4	49	287	27.0	454	768	37	4	59	588	37	529	1154	51	3	46
		200	150	11.8	152	314	48	4	48	297	24.8	350	672	44	4	52	374	43	416	833	45	5	50
		$\bar{X}$	161	11.9	163	336	48	4	48	259	22.5	352	634	41	4	55	457	35	453	945	48	4	48
	Alar	1000	179	16.0	179	374	48	4	48	282	31.9	390	704	40	5	55	502	53	476	1031	49	5	46
		2000	150	12.6	201	364	41	3	56	241	25.5	283	550	44	5	51	363	36	401	800	45	5	50
		$\bar{X}$	161	12.2	176	349	46	3	51	239	24.4	308	571	42	4	54	424	38	430	892	48	4	48
	$\bar{X}$		161	12.1	170	343	47	4	49	249	23.5	330	603	41	4	55	441	37	442	920	48	4	48

solution depend upon the amount of available water in the soil for the growth of plants. In other words, the partial absorption of plant nutrients depends upon the mass flow of water from the soil to the plant roots. The higher the absorption of water, the greater is the accumulation of nutrients in plant tissues. In addition, increasing soil moisture stress resulted in higher soil solution osmotic potential which affected the growth behaviour of the plant thereby the uptake of plant nutrients.

In this respect Vites (1972) concluded that water content of soil affects nutrient transport to the root surface by affecting the rate of diffusion and the mass flow of water to the root. In the latter, ions in solution are simply swept along in the water flow. Ions such as nitrate that are entirely soluble can be completely extracted from a soil by mass flow.

Barber et al. (1963) stated that mass flow can account for most of the transport of Ca, Mg and N but is inadequate to account for much of the transport of P and K.

Growth promoting substances i.e. GA_3 increased the amount of N P K in different plant parts. This trend was found to be true in most of sampling dates. GA_3 treated plants possessed the highest nutrients compared with the corresponding values of the control treatment. Such pattern of results can be discussed on the basis that growth promoting substances enhanced the growth of the treated plants and that increased the absorption of nutrients. These findings may lead to the conclusion that when growth promoting substances are used, the application of N.P.K. must be increased to meet the nutrient demand by plants.

It is worthy to mention that GA_3 treated plants contain the highest amount of nutrients compared with the corresponding values of those sprayed with Alar. Such trend was found to be clear in most of the tested plant organs. Also, the level of GA_3 i.e. 100 ppm was found to be superior in this respect compared with the higher rate (200 ppm). These findings can be related to the effect of higher rate of GA_3 on the growth of soybean plant thereby on nutrient uptake. It has been mentioned previously that the effect of higher level of GA_3 on the growth of soybean was less than that observed with lower level. In addition, increasing the rate of applied Alar did result in a greater depression in the amount of N P K in the different tested plant parts. This can be ascribed to the retarding effect of such chemical on the growth of soybean.

The previous results can be discussed on the basis that growth substances affect plant growth thereby the nutrient uptake. The absorption of different nutrients is controlled by the growth behaviour of the plant and such effect depends upon the type and rate of the growth substances used.

Results of Tables (24 - 26) showed that the promoting or retarding effect of growth regulators depend upon the level of soil moisture and that affects the absorption and accumulation of nu trient in plant tissues. The nutrient accumulation in different plant organs in those plants treated with either promoter (GA_3) or retardant (Alar) seemed to be decreased by increasing soil moisture stress. The plants grown under wet conditions (85 % F.C.) and treated with both growth substances possessed the highest amount of N P K. Increasing soil moisture stress, such accumulation of nutrients decreased. These results lead to the assumption that the regulating effect of growth substances on either plant growth or nutrient uptake depends upon the level of soil moisture.

Tables(27-29) represent the proportion of the three macro-nutrients (N P K) in the whole soybean plant at different stages of growth. Results indicate that K increased with advancing age. Thus it can be concluded that the need of soybean to K is relatively higher and such element must be available for such plant during lat er periods of growth. Also, the rate of K absorption exceeds the rate of N or P absorption especially at lat er periods of growth.

4.6.3. Fe, Mn and Zn Content :

Results of Fe, Mn and Zn contents in different soybean plant organs, during different periods of growth as well as the relative increase, as affected by soil moisture and growth substances are presented in Tables (31 - 36). Also, the distribution of the above mentioned micro-nutrients in different plant organs with respect to the total amount is recorded in Tables (37-39). The percent of the three micro-nutrients in the whole plant throughout its growth cycle is presented in Table..(40).

These results indicate a continous absorption of such nutrients for building up the new developing tissues. These results may show

Table (31) : Effect of soil moisture levels and some regulators on Fe. concentrations (ppm) at different periods of soybean growth.

Treatments		Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)							
Days after sowing	Organs	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm			Irrig. $\bar{X}$
			100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$	
50 days	Root	300	200	300	267	440	140	247	257	320	140	280	247	120	180	207	227	240	280	280	267	120	300	220	244
	Stem	340	340	180	287	120	100	187	237	160	300	280	247	100	290	183	215	160	160	320	213	100	280	180	197
	L. petiols	200	120	460	260	220	440	287	274	280	100	220	200	140	380	267	234	300	260	340	300	360	460	373	337
	L. blades	200	160	480	280	140	340	227	254	400	140	220	253	140	200	247	250	160	160	460	260	260	240	220	240
75 days	Root	280	240	220	247	260	180	240	244	240	180	320	247	100	350	230	239	180	240	220	213	260	340	260	237
	Stem	240	500	240	327	400	320	320	324	380	200	320	300	200	120	233	267	220	480	280	327	180	260	220	274
	L. petiols	220	320	140	227	240	520	327	277	140	440	460	347	300	220	220	284	360	420	400	393	300	480	380	387
	L. blades	140	160	200	167	240	420	267	217	340	100	300	247	300	380	393	320	380	240	440	353	300	160	280	317
	Pods	160	300	400	287	320	160	213	250	340	160	240	280	380	100	273	277	330	120	120	190	260	140	300	245
100 days	Root	140	260	380	260	400	440	327	294	180	220	400	267	160	450	263	265	180	420	420	340	380	200	253	297
	Stem	160	280	200	247	100	200	153	200	460	460	280	400	260	370	363	382	380	460	220	353	160	380	307	330
	L. petiols	400	440	400	413	360	280	347	380	260	470	480	403	420	160	280	342	400	440	400	413	160	180	247	330
	L. blades	340	140	180	220	460	360	387	304	320	220	300	280	100	460	293	287	200	140	480	273	320	420	313	293
	Pods	160	360	400	307	240	140	180	244	380	420	200	333	330	440	383	358	220	220	180	207	220	460	300	254
130 days	Seeds	440	420	450	437	490	400	443	440	340	380	320	347	300	380	340	344	430	370	400	400	490	470	463	432

Table (32) : Effect of soil moisture levels and regulators on Mn. concentrations (ppm) at different periods of soybean growth.

Treatments		Wet (85 % F.C.)								Medium (70 % F.C.								Dry 55 % F.C.)							
Days after sowing	Organs	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$
			100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$	
50 days	Root	490	290	370	383	250	130	290	337	330	150	390	290	330	230	297	294	330	310	210	283	210	330	290	287
	Stem	90	250	290	210	170	210	157	184	110	290	210	203	230	230	190	197	159	230	320	233	110	330	197	215
	L. petiols	170	110	350	210	310	210	230	220	330	160	270	253	170	390	297	275	270	310	110	230	150	230	217	224
	L. blades	210	310	310	277	230	270	237	257	230	190	190	203	190	130	183	193	150	210	210	190	190	330	223	207
75 days	Root	410	250	290	317	390	430	410	364	350	350	230	310	270	170	263	287	150	350	190	230	270	350	257	244
	Stem	330	190	170	230	350	370	350	290	290	190	310	263	410	430	377	320	210	350	150	237	430	130	257	247
	L. petiols	230	190	170	197	210	290	243	220	250	210	190	217	410	210	290	254	310	270	270	283	430	190	310	297
	L. Blades	230	130	170	177	230	330	263	220	350	130	230	237	270	250	290	264	250	210	230	230	170	210	210	220
	Pods	310	250	390	317	430	250	330	324	410	270	350	343	250	150	270	307	410	170	210	263	230	250	297	280
100 dats	Root	170	290	450	303	310	310	263	283	250	450	370	357	310	450	337	347	290	190	330	295	430	430	383	339
	Stem	170	350	230	250	170	230	190	220	250	310	270	277	380	170	267	272	350	230	330	303	410	350	370	337
	L. petiols	130	150	210	163	230	270	210	187	170	290	370	277	290	170	210	244	310	230	170	237	230	170	237	237
	L. blades	190	110	150	150	330	110	210	180	190	270	190	217	130	210	177	197	170	210	270	217	290	330	263	240
	Pods	190	230	150	190	150	190	177	184	190	250	250	230	330	230	250	240	190	210	150	183	270	230	230	207
130 days	Seeds	60	40	60	53	60	40	53	53	40	50	40	43	30	30	33	38	40	50	50	47	40	40	40	44

Table (33) : Effect of soil moisture levels and some growth regulators on Zn. concentrations (ppm) at different periods of soybean growth.

Treaments		Wet (85 % F.C.)								Medium (70 % F.C.)								Dry (55 % F.C.)							
Days after sowing	Organs	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$	Control	GA_3 (ppm)			Alar (ppm)			Irrig. $\bar{X}$
			100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$			100	200	$\bar{X}$	1000	2000	$\bar{X}$	
50 days	Root	50	70	60	60	90	80	73	67	50	70	90	70	60	80	63	67	70	80	70	73	80	100	83	78
	Stem	70	60	70	67	180	70	107	87	60	50	60	57	120	60	80	69	60	70	60	63	70	60	63	63
	L. petiols	110	60	70	80	80	60	83	82	220	60	70	117	70	60	63	90	80	60	100	80	60	70	70	75
	L. Blades	110	140	120	123	100	130	113	118	110	150	120	127	380	280	257	192	120	130	110	120	150	160	143	132
75 days	Root	130	90	60	93	60	110	100	97	60	60	70	63	60	90	70	67	110	60	70	80	50	110	90	85
	Stem	60	130	70	87	100	70	77	82	60	100	50	70	60	70	63	67	60	80	160	100	60	60	60	80
	L. petiols	70	60	60	63	60	100	77	70	60	60	60	60	60	120	80	70	60	60	60	60	70	80	70	65
	L. blades	120	150	220	163	120	110	117	140	140	190	260	197	120	110	123	160	140	220	140	167	100	100	113	140
	Pods	70	100	120	97	110	100	93	95	120	100	140	120	100	100	107	114	120	100	130	117	100	100	107	112
100 days	Root	80	80	80	80	60	180	107	94	60	70	70	67	70	190	107	87	60	70	80	70	60	80	67	69
	Stem	50	70	60	60	100	50	67	64	50	70	40	53	60	50	53	53	60	50	90	67	50	50	53	60
	L. petiols	60	50	60	57	60	70	63	60	50	70	60	60	60	70	60	60	60	60	60	60	60	60	60	60
	L. blades	130	210	120	153	190	120	147	150	120	220	130	157	120	120	120	139	110	130	170	137	130	110	117	127
	Pods	110	130	130	123	130	110	117	120	110	120	120	117	110	140	120	119	110	180	130	140	120	90	107	124
130 days	Seeds	90	100	100	97	130	110	110	104	100	100	90	97	100	100	100	99	90	110	100	100	100	110	100	100

Table (34) : Effect of soil moisture levels and some growth regulators on Fe-content at different periods of soybean growth.

Treatments			50 days					75 days						100 days						% increase		
			Root	Stem	L.P.	L.B.	W.P.	Root	Stem	L.P.	L.B.	Pods	W.P.	Root	Stem	L.P.	L.B.	Pods	W.P.	50	75	100
Wet (85 % F.C.)		0	0.04	0.10	0.03	0.12	0.29	0.08	0.26	0.13	0.12	0.14	0.73	0.06	0.33	0.34	0.51	0.24	1.48	19.6	49.3	100
	GA_3	100	0.03	0.12	0.02	0.12	0.29	0.11	0.94	0.29	0.21	0.37	1.91	0.14	0.81	0.56	0.26	0.82	2.59	11.2	73.7	100
		200	0.05	0.07	0.07	0.32	0.51	0.08	0.45	0.10	0.18	0.44	1.25	0.16	0.89	0.40	0.29	0.83	2.57	19.8	48.6	100
		$\bar{X}$	0.04	0.10	0.04	0.19	0.37	0.09	0.52	0.16	0.17	0.31	1.25	0.12	0.65	0.43	0.36	0.60	2.16	17.1	57.9	100
	Alar	1000	0.06	0.04	0.04	0.09	0.23	0.11	0.54	0.15	0.22	0.30	1.32	0.19	0.24	0.37	0.76	0.41	1.97	11.7	67.0	100
		2000	0.02	0.03	0.07	0.19	0.31	0.06	0.30	0.28	0.34	0.08	1.06	0.19	0.43	0.21	0.47	0.20	1.50	20.7	70.7	100
		$\bar{X}$	0.04	0.06	0.05	0.14	0.29	0.08	0.36	0.19	0.23	0.16	1.02	0.14	0.34	0.30	0.58	0.28	1.64	17.7	62.2	100
	$\bar{X}$		0.04	0.08	0.05	0.16	0.33	0.09	0.44	0.18	0.20	0.23	1.14	0.13	0.48	0.36	0.48	0.43	1.88	17.6	60.6	100
Medium (70 % F.C.)		0	0.04	0.04	0.04	0.17	0.29	0.06	0.31	0.06	0.20	0.10	0.73	0.07	0.45	0.12	0.29	0.38	1.31	22.1	55.7	100
	GA_3	100	0.02	0.09	0.02	0.07	0.20	0.06	0.32	0.22	0.09	0.20	0.89	0.10	0.70	0.33	0.25	0.84	2.22	9.0	40.1	100
		200	0.04	0.10	0.03	0.10	0.27	0.09	0.42	0.15	0.20	0.10	0.96	0.12	0.59	0.19	0.22	0.35	1.47	18.4	65.3	100
		$\bar{X}$	0.03	0.08	0.03	0.12	0.26	0.07	0.37	0.14	0.18	0.13	0.89	0.10	0.62	0.21	0.26	0.53	1.72	15.1	51.7	100
	Alar	1000	0.02	0.03	0.02	0.07	0.14	0.03	0.24	0.13	0.23	0.19	0.82	0.06	0.32	0.21	0.08	0.47	1.14	12.3	71.9	100
		2000	0.02	0.08	0.05	0.07	0.22	0.08	0.08	0.07	0.22	0.04	0.49	0.17	0.42	0.06	0.26	0.39	1.30	16.9	37.7	100
		$\bar{X}$	0.03	0.05	0.04	0.10	0.22	0.06	0.21	0.08	0.26	0.10	0.71	0.10	0.41	0.13	0.23	0.42	1.29	17.1	55.0	100
	$\bar{X}$		0.03	0.07	0.03	0.11	0.24	0.07	0.29	0.11	0.22	0.12	0.81	0.10	0.51	0.16	0.24	0.48	1.49	16.1	54.4	100
Dry (55 % F.C.)		0	0.04	0.04	0.03	0.05	0.16	0.04	0.08	0.09	0.18	0.04	0.43	0.04	0.23	0.13	0.11	0.17	0.68	23.5	38.4	100
	GA_3	100	0.04	0.04	0.03	0.07	0.18	0.07	0.45	0.13	0.14	0.03	0.82	0.14	0.47	0.19	0.11	0.21	1.12	16.1	73.2	100
		200	0.03	0.07	0.04	0.17	0.31	0.06	0.23	0.11	0.24	0.02	0.66	0.18	0.17	0.16	0.34	0.14	0.99	28.3	66.7	100
		$\bar{X}$	0.03	0.05	0.03	0.10	0.21	0.05	0.23	0.11	0.19	0.03	0.61	0.10	0.28	0.16	0.19	0.17	0.90	23.3	67.8	100
	Alar	1000	0.01	0.02	0.04	0.10	0.17	0.07	0.14	0.08	0.16	0.05	0.50	0.11	0.15	0.04	0.22	0.18	0.70	24.3	71.4	100
		2000	0.04	0.06	0.04	0.07	0.21	0.08	0.13	0.10	0.07	0.02	0.40	0.05	0.26	0.05	0.21	0.32	0.89	23.6	44.9	100
		$\bar{X}$	0.02	0.04	0.04	0.08	0.18	0.06	0.12	0.09	0.14	0.05	0.46	0.07	0.23	0.08	0.18	0.23	0.79	22.8	58.2	100
	$\bar{X}$		0.03	0.05	0.04	0.08	0.20	0.06	0.17	0.10	0.17	0.04	0.54	0.08	0.26	0.12	0.18	0.20	0.84	23.8	64.3	100

Table (35) : Effect of soil moisture levels and some growth regulators on Mn. content at different periods of soybean growth (m^2 Mn./plant).

Treatments			50 days					75 days						100 days						% increase		
			Root	Stem	L.P.	L.B.	W.P.	Root	Stem	L.P.	L.B.	Pods.	W.P.	Root	Stem	L.P.	L.B.	Pods	W.P.	50	75	100
Wet (85 % F.C.)		0	0.07	0.03	0.03	0.13	0.26	0.12	0.35	0.13	0.20	0.28	1.08	0.07	0.35	0.11	0.29	0.28	1.10	24	98	100
	GA_3	100	0.05	0.09	0.02	0.23	0.39	0.12	0.36	0.16	0.17	0.31	1.12	0.15	1.01	0.19	0.20	0.52	2.07	19	54	100
		200	0.06	0.11	0.06	0.21	0.44	0.10	0.32	0.12	0.15	0.43	1.12	0.19	0.68	0.21	0.24	0.31	1.63	27	69	100
		X̄	0.06	0.07	0.04	0.19	0.36	0.12	0.37	0.14	0.18	0.34	1.15	0.14	0.66	0.17	0.25	0.37	1.59	23	72	100
	Alar	1000	0.04	0.06	0.04	0.15	0.29	0.16	0.47	0.13	0.21	0.40	1.37	0.15	0.41	0.24	0.55	0.26	1.61	18	85	100
		2000	0.02	0.06	0.03	0.15	0.26	0.14	0.35	0.16	0.26	0.12	1.03	0.13	0.50	0.20	0.14	0.26	1.23	21	84	100
		X̄	0.04	0.05	0.04	0.14	0.27	0.14	0.39	0.14	0.23	0.25	1.15	0.11	0.42	0.18	0.31	0.27	1.29	23	89	100
	X̄		0.05	0.06	0.04	0.16	0.31	0.13	0.39	0.14	0.21	0.30	1.17	0.13	0.53	0.18	0.28	0.32	1.44	22	81	100
Medium (70 % F.C.)		0	0.04	0.03	0.05	0.10	0.22	0.09	0.24	0.10	0.21	0.12	0.76	0.09	0.25	0.08	0.18	0.19	0.79	28	96	100
	GA_3	100	0.02	0.09	0.03	0.10	0.24	0.11	0.30	0.11	0.12	0.20	0.84	0.19	0.47	0.20	0.30	0.50	1.66	14	51	100
		200	0.05	0.07	0.04	0.09	0.25	0.06	0.41	0.06	0.15	0.14	0.82	0.11	0.57	0.15	0.14	0.44	1.41	18	58	100
		X̄	0.04	0.06	0.04	0.10	0.24	0.09	0.33	0.09	0.17	0.17	0.85	0.13	0.43	0.14	0.20	0.36	1.26	19	67	100
	Alar	1000	0.04	0.07	0.03	0.09	0.23	0.08	0.48	0.17	0.21	0.13	1.07	0.12	0.47	0.15	0.11	0.47	1.32	17	81	100
		2000	0.03	0.06	0.05	0.05	0.19	0.04	0.30	0.07	0.14	0.05	0.60	0.17	0.19	0.17	0.12	0.21	0.86	22	70	100
		X̄	0.04	0.06	0.04	0.08	0.22	0.07	0.34	0.11	0.19	0.10	0.81	0.13	0.30	0.10	0.14	0.28	0.95	23	85	100
	X̄		0.04	0.06	0.04	0.09	0.23	0.08	0.34	0.10	0.18	0.03	0.83	0.03	0.36	0.12	0.17	0.32	0.10	21	75	100
Dry (55 % F.C.)		0	0.03	0.03	0.03	0.05	0.14	0.03	0.07	0.08	0.12	0.05	0.35	0.06	0.21	0.10	0.09	0.14	0.60	23	58	100
	GA_3	100	0.04	0.06	0.04	0.09	0.23	0.10	0.33	0.08	0.13	0.04	0.68	0.06	0.24	0.10	0.17	0.20	0.77	30	88	100
		200	0.03	0.07	0.01	0.08	0.19	0.05	0.12	0.08	0.13	0.03	0.41	0.14	0.26	0.07	0.19	0.12	0.78	24	53	100
		X̄	0.03	0.05	0.03	0.07	0.18	0.06	0.17	0.08	0.12	0.05	0.48	0.09	0.24	0.09	0.15	0.15	0.72	25	67	100
	Alar	1000	0.02	0.03	0.02	0.07	0.14	0.08	0.33	0.12	0.09	0.04	0.66	0.13	0.39	0.09	0.20	0.22	1.03	14	64	100
		2000	0.04	0.07	0.02	0.10	0.23	0.08	0.07	0.04	0.10	0.04	0.33	0.11	0.24	0.05	0.16	0.16	0.72	32	46	100
		X̄	0.03	0.05	0.02	0.08	0.18	0.06	0.14	0.07	0.10	0.05	0.42	0.10	0.28	0.08	0.15	0.17	0.78	23	54	100
	X̄		0.03	0.05	0.02	0.07	0.17	0.06	0.15	0.08	0.11	0.05	0.45	0.10	0.20	0.09	0.15	0.17	0.71	24	63	100

Table (36) : Effect of soil moisture levels and some growth regulators on Zn. content at different periods of soybean growth (mg Zn./plant).

Treatments			50 days					75 days						100 days						% increase		
			Root	Stem	L.P.	L.B.	W.P.	Root	Stem	L.P.	L.B.	Pods	W.P.	Root	Stem	L.P.	L.B.	Pods	W.P.	50	75	100
Wet (85 % F.C.)		0	0.007	0.020	0.018	0.066	0.111	0.038	0.064	0.040	0.102	0.063	0.307	0.03	0.102	0.050	0.020	0.164	0.368	30	83	100
	GA_3	100	0.012	0.020	0.011	0.105	0.148	0.041	0.132	0.050	0.197	0.123	0.543	0.042	0.202	0.064	0.038	0.295	0.641	23	85	100
		200	0.009	0.026	0.011	0.080	0.126	0.021	0.130	0.043	0.198	0.131	0.523	0.034	0.178	0.061	0.019	0.270	0.562	22	93	100
		$\bar{X}$	0.009	0.023	0.014	0.082	0.128	0.034	0.139	0.044	0.166	0.104	0.487	0.036	0.158	0.059	0.251	0.240	0.744	17	66	100
	Alar	1000	0.012	0.059	0.014	0.064	0.149	0.025	0.135	0.037	0.112	0.102	0.411	0.029	0.240	0.061	0.315	0.224	0.869	17	47	100
		2000	0.010	0.021	0.010	0.073	0.114	0.035	0.067	0.054	0.088	0.049	0.293	0.076	0.108	0.052	0.156	0.153	0.545	21	54	100
		$\bar{X}$	0.010	0.033	0.013	0.068	0.124	0.034	0.086	0.045	0.101	0.072	0.338	0.046	0.147	0.055	0.220	0.179	0.647	19	52	100
	$\bar{X}$		0.009	0.028	0.014	0.076	0.127	0.035	0.112	0.045	0.132	0.087	0.411	0.041	0.155	0.057	0.236	0.209	0.698	18	59	100
Medium (70 % F.C.)		0	0.007	0.016	0.031	0.046	0.100	0.016	0.049	0.023	0.084	0.035	0.207	0.022	0.049	0.023	0.110	0.109	0.313	32	66	100
	GA_3	100	0.010	0.016	0.010	0.077	0.113	0.019	0.158	0.030	0.171	0.075	0.453	0.030	0.106	0.049	0.246	0.024	0.671	17	68	100
		200	0.012	0.020	0.009	0.053	0.094	0.020	0.066	0.019	0.169	0.057	0.331	0.021	0.084	0.024	0.095	0.209	0.433	18	76	100
		$\bar{X}$	0.009	0.018	0.016	0.06	0.103	0.018	0.087	0.024	0.142	0.058	0.329	0.024	0.082	0.031	0.014	0.185	0.336	31	98	100
	Alar	1000	0.008	0.038	0.011	0.018	0.075	0.018	0.071	0.025	0.094	0.050	0.258	0.028	0.074	0.031	0.100	0.156	0.389	19	66	100
		2000	0.010	0.017	0.007	0.100	0.134	0.021	0.049	0.037	0.063	0.035	0.205	0.070	0.057	0.027	0.068	0.125	0.347	13	59	100
		$\bar{X}$	0.008	0.023	0.016	0.055	0.102	0.018	0.057	0.030	0.080	0.041	0.226	0.041	0.059	0.027	0.092	0.132	0.351	29	64	100
	$\bar{X}$		0.009	0.021	0.016	0.058	0.104	0.019	0.072	0.027	0.109	0.049	0.276	0.032	0.070	0.029	0.118	0.159	0.408	25	68	100
Dry (55 % F.C)		0	0.007	0.014	0.008	0.041	0.070	0.022	0.021	0.015	0.067	0.016	0.141	0.013	0.036	0.019	0.063	0.084	0.215	33	66	100
	GA_3	100	0.010	0.018	0.007	0.053	0.088	0.017	0.075	0.018	0.132	0.023	0.265	0.023	0.051	0.026	0.105	0.175	0.380	21	70	100
		200	0.008	0.014	0.011	0.041	0.074	0.018	0.082	0.017	0.077	0.021	0.215	0.034	0.071	0.023	0.012	0.104	0.244	30	88	100
		$\bar{X}$	0.009	0.014	0.009	0.044	0.076	0.020	0.070	0.017	0.090	0.020	0.217	0.021	0.054	0.023	0.093	0.118	0.309	24	70	100
	Alar	1000	0.009	0.017	0.007	0.059	0.092	0.014	0.046	0.019	0.053	0.019	0.151	0.018	0.048	0.024	0.088	0.096	0.274	34	55	100
		2000	0.012	0.013	0.006	0.048	0.079	0.025	0.031	0.016	0.046	0.014	0.132	0.020	0.034	0.018	0.054	0.063	0.189	42	70	100
		$\bar{X}$	0.009	0.014	0.007	0.049	0.079	0.022	0.032	0.017	0.055	0.016	0.142	0.017	0.040	0.020	0.066	0.080	0.223	35	64	100
	$\bar{X}$		0.009	0.014	0.008	0.045	0.076	0.021	0.050	0.017	0.073	0.018	0.179	0.020	0.047	0.022	0.079	0.099	0.267	28	67	100

Table (37) : Effect of soil proisture levels and some growth regulators on Fe. distribution at different periods of soybean growth.

Treatment			50 days				75 days					100 days				
			Root	Stem	L.P.	L.B.	Root	Stem	L.P.	L.B.	Pods	Root	Stem	L.P.	L.B.	Pods
Wet (85 % F.C.)		0	14	34	10	42	11	36	18	16	19	4	22	23	34	17
	GA_3	100	10	41	7	42	6	49	15	11	19	5	31	22	10	32
		200	10	14	14	62	6	36	8	14	36	6	35	16	11	32
		$\bar{X}$	11	27	11	51	7	42	13	14	24	6	30	20	17	27
	Alar	1000	26	17	17	40	8	41	11	17	23	10	12	19	39	20
		2000	6	10	23	61	6	28	26	32	8	13	29	14	31	13
		$\bar{X}$	14	21	17	48	8	35	19	23	15	9	20	18	35	18
	$\bar{X}$		12	24	15	49	8	39	16	18	19	7	26	19	26	22
Medium (70 % F.C.)		0	14	14	14	58	8	42	8	27	15	5	34	9	22	30
	GA_3	100	10	45	10	35	7	36	25	10	22	5	32	15	11	37
		200	15	37	11	37	9	44	16	21	10	8	40	13	15	24
		$\bar{X}$	12	31	12	45	8	41	16	19	16	6	36	12	15	31
	Alar	1000	14	21	14	51	4	29	16	28	23	5	28	18	7	42
		2000	9	36	22	33	16	16	14	45	9	13	32	5	20	30
		$\bar{X}$	14	23	18	45	8	30	11	37	14	8	32	10	18	32
	$\bar{X}$		13	29	13	45	8	35	14	28	15	7	34	11	16	32
Dry (55 % F.C.)		0	25	25	19	31	9	19	21	42	9	6	34	19	16	25
	GA_3	100	22	22	17	39	9	55	16	17	3	13	42	17	10	18
		200	10	23	13	54	9	35	17	36	3	18	17	16	34	14
		$\bar{X}$	14	24	14	48	8	38	18	31	5	11	31	48	21	19
	Alar	1000	6	12	24	58	14	28	16	32	10	16	21	6	31	26
		2000	19	29	19	33	20	33	25	18	4	6	29	6	24	35
		$\bar{X}$	11	22	22	45	14	27	21	30	8	9	29	10	23	29
	$\bar{X}$		15	25	20	40	11	33	19	31	6	10	31	14	21	24

Table (38) : Effect of soil moisture levels and some growth regulators on Mn. distribution at different periods of soybean growth.

Treatment			50 days				75 days					100 days				
			Root	Stem	L.P.	L.B.	Root	Stem	L.P.	L.B.	Pods	Root	Stem	L.P.	L.B.	Pods
Wet (85 % F.C.)		0	27	12	12	49	11	32	12	19	26	6	32	10	26	26
	GA_3	100	13	23	5	59	11	32	14	15	28	7	49	9	10	25
		200	14	25	14	47	9	29	11	13	38	12	42	13	15	18
		$\bar{X}$	17	19	11	53	10	32	12	16	30	9	42	11	16	22
	Alar	1000	14	21	14	51	12	34	9	15	30	9	25	15	34	17
		2000	8	23	12	57	14	34	16	25	11	11	41	16	11	21
		$\bar{X}$	15	19	15	51	12	34	12	20	22	9	33	14	24	20
	$\bar{X}$		16	19	13	52	11	33	12	18	26	9	37	13	19	22
Medium (70 % F.C.)		0	18	14	23	45	12	32	13	28	15	11	32	10	23	24
	GA_3	100	8	38	13	41	13	36	13	14	24	12	29	11	18	30
		200	20	28	16	36	7	50	7	18	18	8	40	11	10	31
		$\bar{X}$	17	25	17	41	11	39	11	20	19	10	34	11	16	29
	Alar	1000	17	30	13	40	7	45	16	20	12	9	36	11	8	36
		2000	16	32	26	26	7	50	12	23	8	20	22	20	14	24
		$\bar{X}$	18	27	18	37	9	42	14	23	12	14	32	11	15	28
	$\bar{X}$		17	26	17	40	10	41	12	22	15	12	33	11	15	29
Dry (55 % F.C.)		0	21	21	21	37	9	20	23	34	14	10	35	17	15	23
	GA_3	100	17	26	17	40	15	49	12	19	5	8	31	13	22	26
		200	16	37	5	42	12	29	20	32	7	18	33	9	24	16
		$\bar{X}$	17	28	17	38	13	35	17	25	10	13	33	13	21	20
	Alar	1000	14	21	14	51	12	50	18	14	6	13	38	9	19	21
		2000	17	30	9	44	24	21	12	30	13	15	33	7	22	23
		$\bar{X}$	17	28	11	44	14	33	17	24	12	13	36	10	19	22
	$\bar{X}$		18	29	12	41	13	33	18	24	12	14	28	13	21	24

Table (39) : Effect of soil moisture levels and some growth regulators on Zn. distribution at different periods of soybean growth.

Treatment			50 days				75 days					100 days				
			Root	Stem	L.P.	L.B.	Root	Stem	L.P.	L.B.	Pods	Root	Stem	L.P.	L.B.	Pods
Wet (85 % F.C.)		0	6	18	16	60	12	21	13	33	21	8	28	14	5	45
	GA_3	100	8	14	7	71	8	24	9	36	23	7	32	10	6	45
		200	7	21	9	63	4	25	8	38	25	6	32	11	3	48
		$\bar{X}$	7	18	11	64	7	29	9	34	21	7	31	12	5	45
	Alar	1000	8	40	9	43	6	33	9	27	25	3	28	7	36	26
		2000	9	18	9	64	12	23	18	30	17	14	20	10	29	27
		$\bar{X}$	8	27	10	55	10	26	13	30	21	7	23	9	34	27
	$\bar{X}$		7	22	11	60	9	27	11	32	21	6	22	8	34	30
Medium (70 % F.C.)		0	7	16	31	46	8	24	11	41	16	7	16	7	35	35
	GA_3	100	9	14	9	68	4	35	7	38	16	4	16	7	37	36
		200	13	21	10	56	6	20	6	51	17	5	19	6	22	48
		$\bar{X}$	9	17	16	58	5	26	7	43	19	7	24	9	4	56
	Alar	1000	11	51	15	23	7	28	10	36	19	7	19	8	26	40
		2000	7	13	5	75	10	24	18	31	17	20	16	8	20	36
		$\bar{X}$	8	23	16	53	8	25	13	35	19	12	17	8	26	37
	$\bar{X}$		9	20	15	56	7	26	10	39	18	8	17	7	29	39
Dry (55 % F.C.)		0	10	20	11	59	16	15	11	48	10	6	17	9	29	39
	GA_3	100	11	20	8	61	6	28	7	50	9	6	13	7	28	46
		200	11	19	15	55	8	38	8	36	10	14	29	9	5	43
		$\bar{X}$	12	18	12	58	9	32	8	41	10	7	17	7	30	39
	Alar	1000	10	18	8	64	9	30	13	35	13	7	18	9	32	34
		2000	15	16	7	62	19	23	12	35	11	11	18	10	29	32
		$\bar{X}$	11	18	9	62	15	23	12	39	11	8	18	9	30	35
	$\bar{X}$		12	18	11	59	12	28	9	41	10	7	18	8	30	37

Table (40) : The relationships between Fe, Mn and Zn content of whole soybean plant throughout the different stages of growth.

Treatments			50 days							75 days							100 days						
			mg./plant				% of total amount			mg./plant				% of total amount			mg./plant				% of total amount		
			Fe	Mn	Zn	Total	Fe	Mn	Zn	Fe	Mn	Zn	Total	Fe	Mn	Zn	Fe	Mn	Zn	Total	Fe	Mn	Zn
Wet (85 % F.C.)		0	0.29	0.26	0.111	0.661	44	39	17	0.73	1.08	0.307	2.117	34	51	15	1.48	1.10	0.368	2.948	50	37	13
	GA_3	100	0.29	0.39	0.148	0.828	35	47	18	1.91	1.12	0.913	3.573	53	31	16	2.59	2.07	0.641	5.301	49	39	12
		200	0.51	0.44	0.126	1.076	47	41	12	1.25	1.12	0.523	2.893	43	39	18	2.57	1.63	0.562	4.762	54	34	12
		X̄	0.36	0.36	0.128	0.848	42	42	16	1.30	1.11	0.458	2.861	45	39	16	2.21	1.60	0.524	4.337	51	37	12
	Alar	1000	0.23	0.29	0.149	0.669	34	43	23	1.32	1.37	0.411	3.101	43	44	13	1.97	1.61	0.869	4.449	44	36	20
		2000	0.31	0.26	0.114	0.684	45	38	17	1.06	1.03	0.293	2.383	44	43	13	1.50	1.23	0.545	3.275	46	38	16
		X̄	0.28	0.27	0.125	0.671	42	40	18	1.04	1.16	0.337	2.534	41	46	13	1.65	1.31	0.594	3.554	46	37	17
	X̄		0.32	0.32	0.127	0.760	42	42	16	1.17	1.14	0.398	2.698	43	42	15	1.93	1.46	0.559	3.946	49	37	14
Medium (70 % F.C.)		0	0.29	0.22	0.100	0.61	48	36	16	0.73	0.76	0.207	1.697	43	45	12	1.31	0.79	0.313	2.413	54	33	13
	GA_3	100	0.20	0.24	0.113	0.553	36	43	21	0.89	0.84	0.453	2.183	41	38	21	2.22	1.66	0.671	4.551	49	36	15
		200	0.27	0.25	0.094	0.614	44	41	15	0.96	0.82	0.331	2.111	45	39	16	1.47	1.41	0.433	3.313	44	43	13
		X̄	0.25	0.24	0.102	0.592	42	41	17	0.86	0.81	0.330	1.997	43	41	16	1.67	1.29	0.472	3.426	49	38	13
	Alar	1000	0.14	0.23	0.075	0.445	31	52	17	0.82	1.07	0.258	2.148	38	50	12	1.14	1.32	0.389	2.849	40	46	14
		2000	0.22	0.19	0.134	0.544	40	35	25	0.49	0.60	0.205	1.295	38	46	16	1.30	0.86	0.347	2.507	52	34	14
		X̄	0.22	0.21	0.103	0.533	41	39	20	0.68	0.81	0.223	1.713	40	47	13	1.25	0.99	0.350	2.590	48	38	14
	X̄		0.24	0.23	0.103	0.573	42	40	18	0.77	0.81	0.277	1.855	42	44	14	1.46	1.14	0.411	3.008	49	38	13
Dry (55 % F.C.)		0	0.16	0.14	0.070	0.370	43	38	19	0.43	0.35	0.141	0.921	47	38	15	0.68	0.60	0.215	1.495	45	40	15
	GA_3	100	0.18	0.23	0.088	0.498	36	46	18	0.82	0.68	0.265	1.765	46	39	15	1.12	0.77	0.380	2.270	49	34	17
		200	0.31	0.19	0.074	0.574	54	33	13	0.66	0.41	0.215	1.285	51	32	17	0.99	0.78	0.244	2.014	49	39	12
		X̄	0.22	0.19	0.077	0.487	45	39	16	0.64	0.48	0.207	1.324	48	36	16	0.93	0.72	0.280	1.926	48	37	15
	Alar	1000	0.17	0.14	0.092	0.402	42	35	23	0.50	0.66	0.151	1.311	38	50	12	0.70	1.03	0.274	2.004	35	51	14
		2000	0.21	0.23	0.079	0.519	40	44	16	0.40	0.33	0.132	0.862	46	38	16	0.89	0.72	0.189	1.799	49	40	11
		X̄	0.18	0.17	0.074	0.430	42	40	18	0.44	0.45	0.141	1.031	43	44	13	0.76	0.78	0.226	1.766	43	44	13
	X̄		0.20	0.18	0.076	0.456	44	39	17	0.54	0.47	0.174	1.178	46	40	14	0.85	0.75	0.253	1.846	46	41	13

that soybean plant must be supplied with these nutrients for better growth. Zink content showed a continous increase from 50 to 75 days after sowing, then a jump in its content was observed at lat er periods (100 days). Such results were found to be clear under wet and medium soil moisture level. However, under dry treatment (55 % F.C.) Fe, Mn and Zn seemed to be increased continously by advancing age but less than those observed in other soil moisture treatment. Such effect may be due to the relationship between Zn element absorption as well as translocation and water deficit.

As for the effect of growth substances, results showed that Fe content of soybean plant increased at the first stage of growth by higher rate of GA_3 (200 ppm). However, Mn and Zn values decreased from the same treatment. This trend was found to be clear under wet treatment (85 % F.C.) as well as at latter stages. The use of Alar seemed to decrease the absorption of micro-nutrients. Such decrease was enhanced by higher rate of Alar. This can be related to the retarding effect of Alar and decreased growth. The reduction in growth may be the cause of the decrease in the content of these element.

It is worthy to mention that under the application of growth substance a slight inbalance between Macro and Micro nutrients was observed. Such inbalance can be related to the regulating effect of these chemicals on the absorption and accumulation of nutrients within plant tissues . Accordingly, the regulating effect of growth substances may be due partially to the inbalance of nutrient uptake and accumulation in soybean plant tissues. Also, soil moisture stress is another factor affecting the absorption mechanism of nutrients which in turn affects plant growth. For acheiving the effect of these substances, the plant must be supplied with those micro-nutrients if their availability in the soil are insufficient.