4. RESULTS AND DISCUSSION

4.1. The effect of spraying clover plant with various growth regulators types and concentrations at different dates on its growth and quality :

4.1.1. The effect on plant height :

The data concerning the effect of various growth regulators (GR) treatments on clover growth were presented in Tables (1-3).

It could be noticed from these tables that inspite of the promotive effect of the two types of growth regulators used in this study (IAA and GA_3) there were great differences between their effects on plant height, where GA_3 was more effective than IAA in this respect. This effect was true during the whole growth period, where at the first cut, the plant height was 41 and 46.7cm for the application of IAA and GA_3 respectively (regardless its concentration and date of spraying). The corresponding values at the second cut were 50.3 and 67.3 for IAA and GA_3 respectively, while at the third cut the plants height were 45.5 and 67.4cm for IAA and GA_3 respectively. This may explained by the hypothesis of Krishnamoorthy (1981) that the effect of GA_3 on cell elongation and division is mediated through its effect on auxin activity. This hypothesis based on the presence of IAA in high concentration in the plant treated with GA_3. In the plant pody, IAA is oxidized and rendered inactive by peroxidase and IAA oxidase. IAA oxidase

Tabel (1) : Clover plant growth at the first cut as affected by growth regulators application :

Rate ppm.	Plant height (Cm)			Fresh weight (g.pot $^{-1}$)			Dry weight (g.pot $^{-1}$)		
	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
0	37.97	37.63	37.80	82.22	7940	80.81	8.12	8.20	8.16
50	40.50	48.17	44.34	84.16	90.45	87.31	8.61	8.54	8.58
100	43.77	51.60	47.69	95.41	99.73	97.57	9.96	10.45	10.21
200	41.80	49.50	45.65	82.20	97.41	89.81	8.63	10.44	9.54
Mean	41.01	46.73	43.87	86.00	91.75	88.88	8.83	9.41	9.12

Tabel (2) Clover Plant Growth at The Second Cut as affected by G.R. application :

Spraying Time	Rate ppm.	Plant height (Cm)			Fresh weight (g.pot^{-})			Dry weight (g.pot^{-})		
		IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
1st	0	45.93	47.57	46.75	64.68	60.48	62.58	6.38	6.51	6.45
	50	50.67	66.20	58.44	76.41	73.39	74.90	9.69	6.77	8.23
	100	52.70	79.10	65.90	88.90	84.61	86. 6	9.59	9.07	9.33
	200	51.53	77.23	64.38	77.44	76.76	77.10	9.25	7.72	8.49
	Mean	50.21	67.53	58.87	76.86	73.81	75.34	8.73	7.52	8.13
2nd	0	45.50	45.57	45.54	67.09	67.93	67.51	7.21	6.60	6.91
	50	51.43	66.73	59.08	75.92	86.26	81.09	7.66	8.69	8.18
	100	53.37	78.50	65.94	86.89	84.19	85.54	9.07	9.07	9.07
	200	51.63	77.47	64.55	77.32	86.62	81.97	7.67	8.57	8.12
	Mean	50.48	67.07	58.78	76.81	81.25	79.03	7.90	8.23	8.07
Average	0	45.72	46.57	46.15	65.89	64.21	65.05	6.80	6.56	6.68
	50	51.05	66.47	58.76	76.17	79.83	78.00	8.68	7.73	8.21
	100	53.04	78.80	65.92	87.90	89.40	86.15	9.33	9.07	9.20
	200	51.58	77.35	64.47	77.38	81.69	79.54	8.46	8.15	8.31
	Mean	50.35	67.30	58.83	76.84	77.53	77.19	8.32	7.88	8.10

Tabel (3): Clover plant growth at the third cut as affected by G.R. application :

Spraying Time	Rate ppm.	Plant height (Cm)			Fresh weight (g.pot $^{-1}$)			Dry weight (g.pot $^{-1}$)		
		IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
1st	0	50.4	51.4	50.9	101.0	104.1	102.6	10.25	9.37	9.81
	50	54.4	65.0	59.7	117.1	121.7	119.4	12.77	9.81	11.29
	100	57.5	70.6	64.1	139.7	145.7	142.7	15.82	11.12	13.47
	200	56.4	68.5	62.5	119.6	126.2	122.9	12.48	9.93	11.24
	Mean	54.7	63.9	59.3	119.4	124.4	121.9	12.83	10.06	11.45
2nd	0	50.8	50.4	50.6	108.0	111.4	109.7	9.84	10.05	9.95
	50	53.6	64.4	59.0	129.2	132.2	130.7	12.85	13.01	12.93
	100	55.2	74.8	65.0	136.9	149.4	143.2	15.27	15.79	15.53
	200	53.9	71.8	62.9	130.4	141.3	135.9	13.63	14.48	14.06
	Mean	53.4	65.4	59.4	126.1	133.6	129.9	12.90	13.33	13.12
3rd	0	50.3	51.3	50.8	109.2	107.6	108.4	9.03	11.27	10.15
	50	56.1	78.3	67.2	125.2	127.0	126.1	13.12	13.88	13.50
	100	58.6	85.2	71.9	169.9	161.8	165.9	17.95	21.19	19.57
	200	56.8	76.4	66.6	133.2	147.7	140.5	14.30	17.09	15.70
	Mean	55.5	72.8	64.2	134.4	136.0	135.2	13.60	15.86	14.73
Average	0	50.5	51.0	50.8	106.1	107.7	106.9	9.71	10.23	9.97
	50	54.7	69.2	62.0	123.8	126.9	125.4	12.91	12.23	12.57
	100	57.1	76.9	67.0	148.8	152.3	150.6	16.35	16.03	16.19
	200	55.7	72.2	64.0	127.7	138.4	133.1	13.47	13.83	13.66
	Mean	54.5	67.4	61.0	126.6	131.3	128.9	13.11	13.08	13.10

becomes inactivated by a number of diphenols occuring in plants. Increase in the quantity of dipolyphenol by the application of GA_3 has been shown in pea plants. This in turn decrease the activity of IAA oxidase. As a result, auxin is saved from being inactivated by oxidation.

Concerning the effect of GR application time, irrispective of its types and concentrations, it was observed that, at the first cut, the tallest plants was those sprayed with GR before cutting by 21 days where the other plants did not recieved any treatment (as the control). However, at the second cut there was no differences between the plants sprayed with GR before the first cut and those sprayed before the second cut where the plant height were 58.8 and 58.7 cm respectively, but both are taller than the untreated plants (its height was 46.15cm). This indicated that some of GR applied before the first cut translocated to the roots, which was sufficient to promote elongation of shoots during the next growth period, in the same manner as it was applied before the second cut. At the third cut, the tallest plants were those sprayed with GR before this cut by 21 days (the average of plant height reached 64.2 cm), while there was no differences between the other two spraying date (The plant height was 59.3 and 59.4 for the first and second spraying dates).

For the interaction between GR type x date of spraying, it was noticed that for each growth type, there was no obvious differences between various dates of spraying except in the first cut where the plants sprayed with either IAA or GA_3 was taller than the untreated

plants and at the third cut where the plants sprayed with GA_3 before the cutting by 21 days were taller than those sprayed before the first or the second cut. However, at each spraying date, GA_3 was more effective than IAA in increasing plant height, which could be attributed to the inhibitory effect of GA_3 on the activity of peroxidase and IAA oxidase enzymes which inactivated IAA and restricts its effect as explained before.

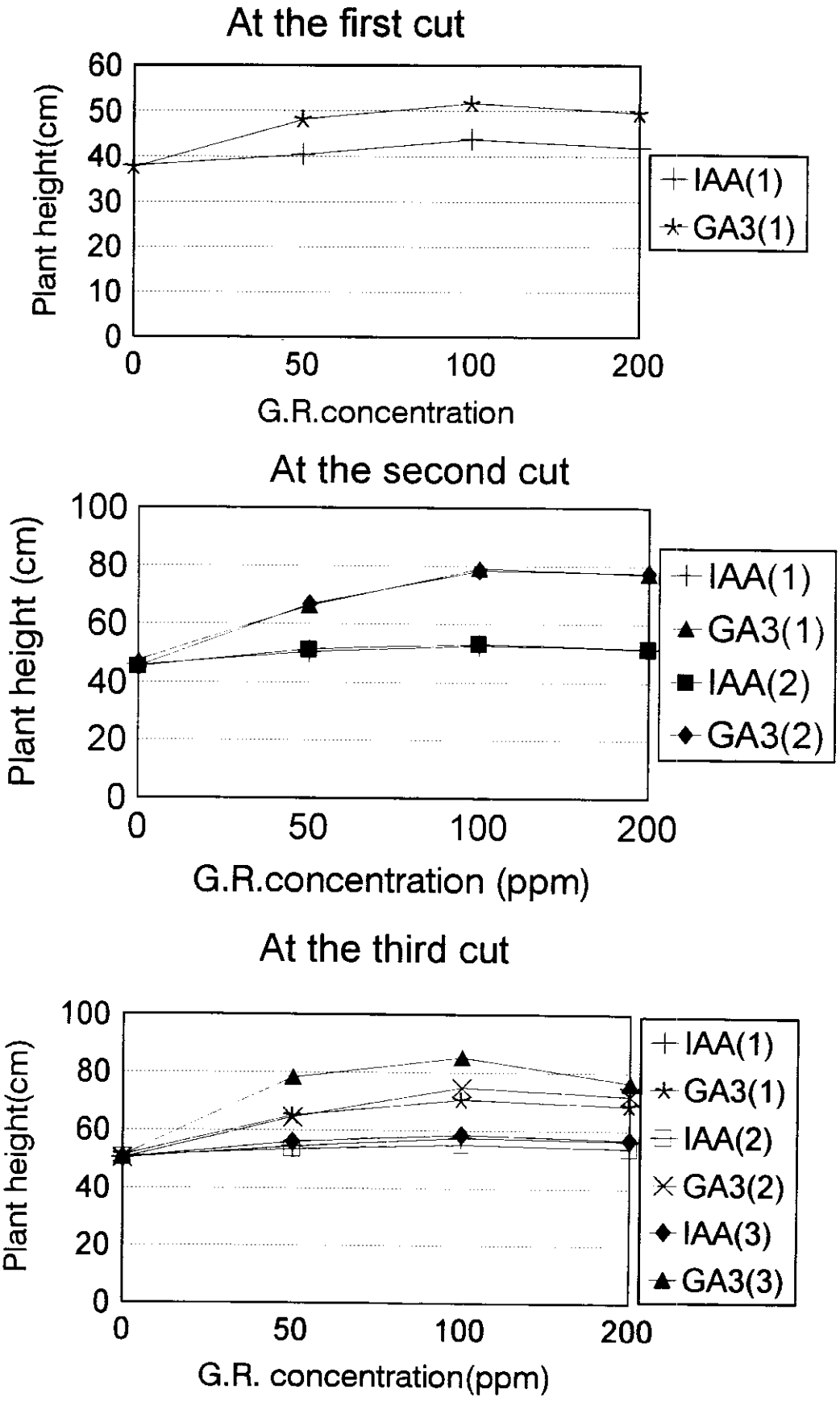
Regarding the effect of GR application rate irrespective of its type and spraying date, the obtained data revealed that the plant height was increased by increasing the concentration of GR up to 100 ppm, while further increase up to 200 ppm slightly reduced this promoting effect. This was true throughout the whole growth period, where at the first cut, the plant height was 37.8, 44.3, 47.96 and 45.6 cm for 0, 50, 100 and 200 ppm GR concentration respectively (regardless its type), while at the second cut, the corresponding values were 46.15, 58.7, 65.9 and 64.5cm respectively and at the third cut these values were 50.8, 62, 67 and 64cm respectively. The less effectivness of higher rate of GR was in accordance with the finding of Bidwell (1979) who stated that IAA and GA_3 activities include both stimulation (principally cell elongation) and inhibition of growth of the same cell or structure may exhibit opposite response depending on the concentration of IAA and GA_3.

Concerning the interaction between GR type and rate, it was found that regardless time of application, increasing application rate of either IAA or GA_3 up to 100 ppm increased plant height. However

further increase in application rate was less effective. This was true throughout the whole growth period (for the three cuts). GA_3 was more effective in this respect than IAA. This could be explained by the above hypothesis, where some of the applied IAA becomes inactivated in the plants, thus its effect was diminished while the application of GA decreased the inactivation of auxin, thus increased its effect. This hypothesis was confirmed by the finding of Bidwell (1979) who found that added IAA is very rapidly inactivated in most tissues.

For the interaction between spraying date and the concentration of GR (regardless its type), the obtained data exhibit that, for various spraying date, the plant height was increased by increasing the concentration of GR up to 100 ppm but excessive application of GR did not induce further increase in plant height. This was true throughout the whole growth period. On the other hand, it was found that at each GR application rate, spraying the plants before the first cut was more effective in increasing plant height during the first growth period, where the other treatments were not applied yet. At the second cut, there was no differences between the two spraying dates (spraying before the first cut and spraying before the second cut) while the third spraying time was not come yet. However, at the third cut, at each GR application rate, the third spraying date (spraying before the third cut by 21 days) was more effective than the other two spraying dates.

Fig.1:The effect of various growth regulators treatments on height of clover plant



Concerning the interaction between GR type x spraying date xGR concentration, the obtained data revealed that, at the first cut the most effective treatment was spraying the plants with 100 ppm GA_3 before this cutting by 21 days, where the plant height reached 51.6 cm. At the second cut, the tallest plants were those sprayed with 100 ppm GA_3 either before the first cut or before the second cut by 21 days. However, at the third cut, the superiority was due to the application of 100 ppm GA_3 before this cut by 21 days where the plant height reached 85.2 cm. Figure (1a,b abd c) illustrated the effect of growth regulators on clover plant height.

The effect of IAA and GA_3 on plant height could be explained by their stimulation effect on cell elongation. In this respect, Bidwell (1979) illustrated that the IAA effect on growth is directly related to its effect on cell wall plasticity, it also stimulate stem elongation and cell division in cambium. Moreover, Fahmy et al. (1983), Jones (1973) and Hussein (1980) stated that GA_3 promote cell elongation and divisions in many dwarf and bushy plants.

4.1.2. The effect on fresh weight :

The data presented in Tables (1-3) reflect that there was no significant differences between the two growth regulators (IAA and GA_3) regarding their effect on plant fresh weight, where the average fresh weight of the plant at the first cut were 86 and 91.75 gm/pot for IAA and GA_3 respectively (average across GR concentration and spraying time). The corresponding values at the second cut were 76.8

and 77.5 g/pot for IAA and GA_3 respectively, while at the third cut, these values were 126.6 and 131.3 gm/pot respectively.

This reveals that GA_3 induced slight increase in plant fresh weight over that induced by IAA. This could be attributed to the effect of GA_3 on accelerating enzymes activity, accordingly, an increase in the contents of simple organic compounds and monosacharids was expected which induced an increase in cell moisture content and plant fresh weight. The effect of GA_3 on protiolytic enzymes activity was recorded by Fahmy et al. (1983).

Concerning the effect of application date, it was noticed that, at the first cut, there was little differences between the treated and untreated plants, where the relative increase in fresh weight due to application of GR (regardless its type and concentration) was 9.9% related to the untreated plants. However, at the second cut, there was no preceptible differences in the fresh weight of the plants sprayed with GR before the first cut and those sprayed before the second cut where the fresh weight (as average across growth regulator types and concentrations) was 75.34 and 79.03 gm/pot for the first and second spraying date respectively, but both are higher than the untreated plants (67.5 gm/pot). At the third cut, the superior growth was obtained by spraying the plants with GR (regardless its type and concentration) before this cut by 21 days.

For the interaction between GR types and spraying date, the obtained data reflect that, at the first cut, the highest fresh weight (91.7 gm/pot) was obtained by spraying the plant with GA_3 before

and 77.5 g/pot for IAA and GA_3 respectively, while at the third cut, these values were 126.6 and 131.3 gm/pot respectively.

This reveals that GA_3 induced slight increase in plant fresh weight over that induced by IAA. This could be attributed to the effect of GA_3 on accelerating enzymes activity, accordingly, an increase in the contents of simple organic compounds and monosacharids was expected which induced an increase in cell moisture content and plant fresh weight. The effect of GA_3 on protiolytic enzymes activity was recorded by Fahmy et al. (1983).

Concerning the effect of application date, it was noticed that, at the first cut, there was little differences between the treated and untreated plants, where the relative increase in fresh weight due to application of GR (regardless its type and concentration) was 9.9% related to the untreated plants. However, at the second cut, there was no preceptible differences in the fresh weight of the plants sprayed with GR before the first cut and those sprayed before the second cut where the fresh weight (as average across growth regulator types and concentrations) was 75.34 and 79.03 gm/pot for the first and second spraying date respectively, but both are higher than the untreated plants (67.5 gm/pot). At the third cut, the superior growth was obtained by spraying the plants with GR (regardless its type and concentration) before this cut by 21 days.

For the interaction between GR types and spraying date, the obtained data reflect that, at the first cut, the highest fresh weight (91.7 gm/pot) was obtained by spraying the plant with GA_3 before

this cut by 21 days, where other GR application dates did not come yet. At the second cut, the plant sprayed by GA_3 before the second cut by 21 days produced higher fresh weight (81.2 gm/pot) than those sprayed with it before the first cut where the plant fresh weight was 73.81 gm/pot), while there was no differences in the fresh weight of the plants sprayed with IAA either before the first or the second cut (76.8 gm/pot for each one). However at the third cut, the highest fresh weight was obtained by spraying the plants with IAA or GA_3 just before this cut (134.4 and 136 gm/pot respectively) with little differences between the effect of the two growth regulators. It is worth to mention here that the plants sprayed with GA_3 before the second cut produced fresh weight (133.6 gm/pot) resembling those produced by the plants sprayed with GR_3 before the third cut which reflect that the effect of GA_3 was prolonged for sometimes, where the plant sprayed with GA3 before the first cut did not exhibit the same response (where the plant fresh weight was 124.4 gm/pot).

Concerning the effect of GR application rate (regardless its type and spraying date), the obtained data revealed that increasing application rate of GR up to 100 ppm increased plant fresh weight (where it reached 97.5, 86.1 and 150.6 gm/pot at the first, second and third cut respectively) while increasing GR application rate up to 200 ppm reduced its promotive effect, but is still higher than the control.

Regarding the interaction between GR type and rate, it was noticed that for each growth regulator type, the highest plant response was obtained at 100 ppm application rate while increasing their application rate up to 200 ppm reduced the enhancing effect. But there

was no significant differences between the two GR types at each application rate.

For the interaction between spraying date and GR application rate, it could be noticed from the results, that at each spraying date, increasing the application rate up to 100 ppm increased plant fresh weight (regardless growth regulators type). This was true at the three cut. However, further increase in the application rate up to 200 ppm was less effective.

Finaly, the interaction between growth regulators type x application date x application rate, reflect that, at the first cut the highest fresh weight was obtained by the application of GA_3, 21 days before cutting. Moreover, at this cut, GA_3 was more effective than IAA at each application rate. However, at the second cut, at each application rate, there was no appreciable differences between the two GR (IAA and GA_3) or between the application date, concerning their effect on plant fresh weight, except the application of 200 ppm GA_3 before the second cut by 21 days, which produced fresh weight (86.6 gm/pot) higher than that of IAA at the same treatment (77.3 gm/pot), and higher than the treatment with 200 GA_3 before the first cut (76.7 gm/pot). On the other hand, at the third cut, it was noticed that at each application rate of IAA or GA_3, the third application date (21 days before the third cut) was more effective than the second application date which in turn more effective than the first application date. Generally, at this cut, the highest fresh weight was produced by the

application of 100 ppm IAA 21 days before the third cut where it reached 169.9 gm/pot.

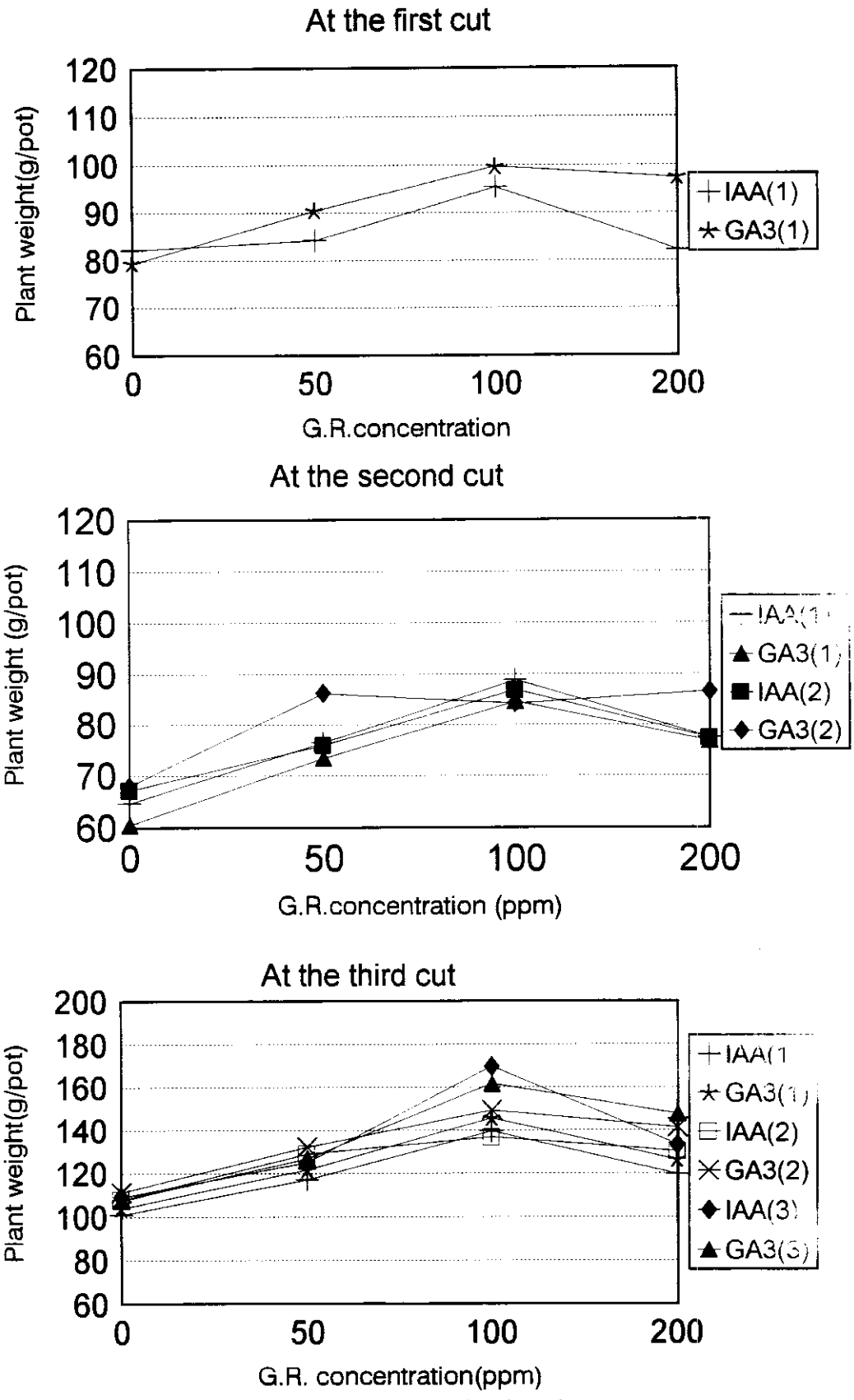
For more accurate comparison between various treatments, the fresh weight of the plants at the three cuts were gathered for each treatment and presented in Fig.(2a,b and c). It could be noticed from this figure that there was little differences between IAA and GA on their effect on fresh weight of the plants where it reached 286.6 and 289.18 gm/pot for IAA and GA_3 respectively (as an average across GR rate and application date).

Concerning the effect of application date on the total fresh weight of the plant (collection of the three cuts), it was found that the application of GR 21 days before the second cut (regardless its type and concentrations) was little but effective than the other two application dates.

The obtained data reflect also that at the first and second application dates GA_3 was more effective than IAA, while at the third application date, IAA was more efficient. Moreover, for GA_3, the second application date produced the highest fresh weight compared with the first and third application date, while for IAA the third application date was more suitable in this respect.

Regardless growth regulator types and application date, it was found that increasing application rate up to 100 ppm induced an increase in the fresh weight reached 24.8% related to the control, while further increase in GR application rate up to 200 ppm reduced its effectiveness where the relative increase in plant fresh weight reached 15.2% only.

Fig.2:The effect of various growth regulators treatments on fresh weight of clover plant



(1) :First application date (2) second application date
(3) : third application date

Generally, it could be concluded that the highest total fresh weight (the summation of the three cuts) was obtained by the application of 100 ppm GA_3 or IAA 21 days before the first cut where the fresh weight reached 324 and 330 gm/pot for IAA and GA_3 respectively. This revealed that the application of growth regulate at suitable concentration just before the first cut promote root growth which in turn increased the uptake of water and nutrients resulting vigorous plants in the subsequent cuts. The enhancement of root growth by GA_3 application was reported by many workers (Edwards and Scott, 1977; Elliott, 1977 and Eweida et al. 1984).

4.1.3. The effect on dry weight :

The data presented in Tables (1-3) illustrated that growth regulators applied in this experiment (IAA and GA_3) were effective in increasing dry matter accumulation in the plant, regardless the date of application and the concentration of GR. This was true throughout the whole growth period. However, there was slight differences between IAA and GA_3 in their effect on plant dry weight.

Concerning the effect of application date, regardless GR type and application rate, the data revealed that at the first and second cut, there was no appreciable differences between the plants sprayed before the first cut and those sprayed before the second cut. However, at the third cut, the plants sprayed with GR just before this cut by 21 days accumulated more dry matter than those sprayed with GR before the first or the second cut.

For the interaction effect of GR type and application date (regardless GR concentration) it was noticed that at the first cut, spraying the plant with GA_3 before this cut by 21 days increased dry matter accumulation more than IAA treatment. However, at the second cut there was no significant differences between the two types of GR and the two application date, where the plant dry weight fluctuated between 8.7 to 7.5 gm/pot, while at the third cut, it was noticed that for each GR the application before this cut was more effective than the other two application dates. Moreover, the highest dry weight was obtained by GA_3 application before the third cut by 21 days where it reached 15.86 gm/pot.

Regarding the effect of GR application rate (as an average across GR types and application date), the obtained results reflect that the highest effect was obtained at 100 ppm GR concentration, which was true for the three cuts.

For the interaction between GR type and application rate, it could be observed that, for each GR (IAA and GA_3) increasing application rate up to 100 ppm increased dry matter accumulation but further increase up to 200 ppm was less effective. Moreover, at each application rate there was little differences between the action of the two GR.

Regarding the interaction between application date and rate, it was found that at each application date, the highest dry weight was obtained at 100 ppm GR concentration (regardless its type) which was true at the three cuts.

Generally, the interaction between GR type x application date xGR concentration revealed that at the first cut the highest dry weight was obtained by the application of 100 ppm GA_3 before this cut by 21 days. However, at the second cut, the highest dry weight was obtained by the application of 100 ppm of IAA or GA_3 either before the first cut or the second cut. At the third cut, the highest dry matter accumulation was induced by the application of 100 ppm GA_3 just before the cutting by 21 days, where the dry weight of the plant reached about 2 fold that of the control.

Finally, for accurate evaluation of the different treatments, the summation of the dry matter at the three cuts for each treatment were compared. The obtained data revealed that there was no differences between the two GR types where the total plant dry weight during the whole growth season reached 29.41 and 29.13 gm/pot for IAA and GA_3 respectively (as an average across application date and rate). However there was slight increase in dry weight obtained by delaying the application date (regardless GR type and concentration) where the average dry weight reached 28.68, 29.34 and 29.79 gm/pot for the plants sprayed with GR 21 days before the first cut, second cut and third cut respectively. Moreover, for the interaction between GR type and application date, it was found that the application of IAA before the first cut or GA_3 before the third cut were the most effective treatments, while for the application rate, the highest promotive effect on dry matter accumulation was obtained by application of 100 ppm

GR regardless its type and application date where the plant dry weight reached 33.46 gm/pot.

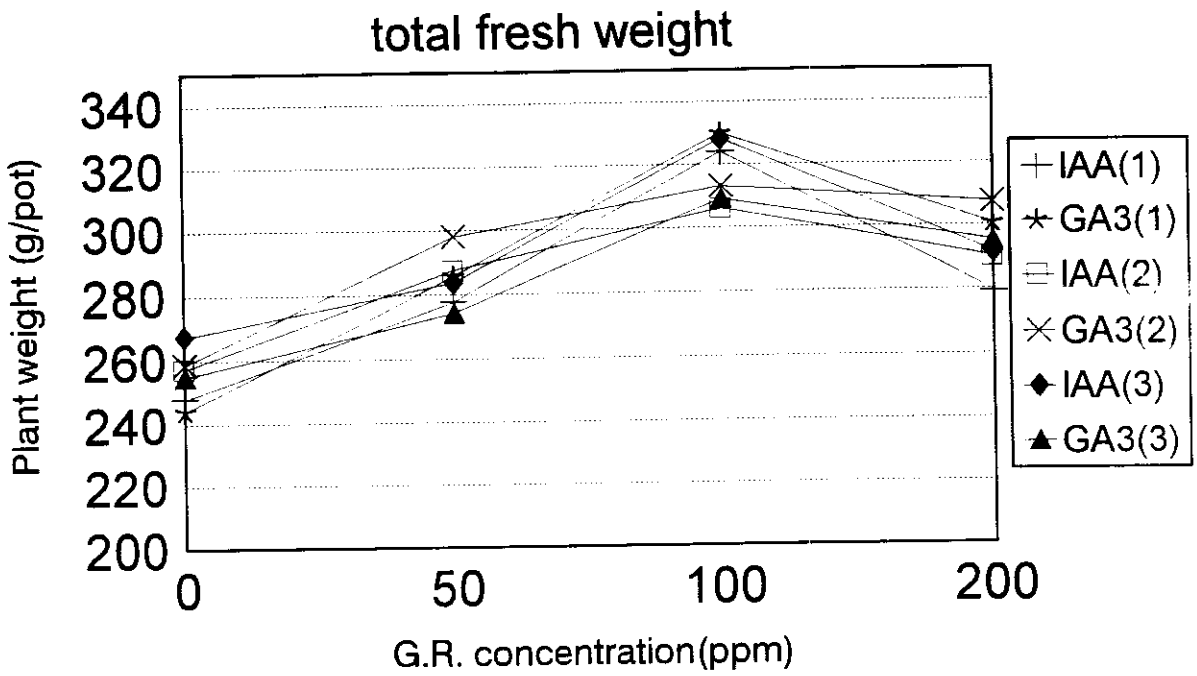
For the interaction between type and rate, it was found that for each GR type, increasing the application rate up to 100 ppm increased its effect on dry matter accumulation, however an excessive application of GR over 100 ppm reduced its efficiency.

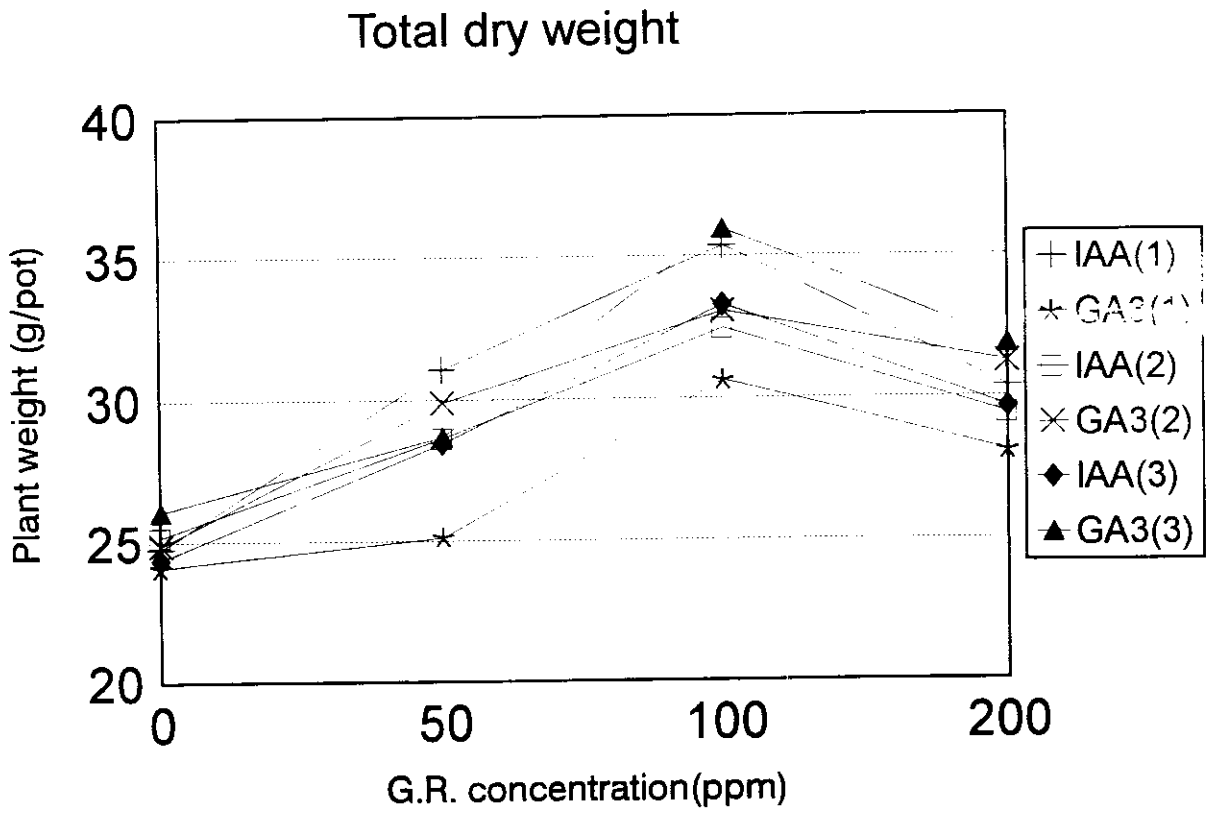
Moreover, at each application rate, there was no appreciable difference between IAA and GA_3 regarding their effect on plant dry weight.

About the interaction effect of application date and application rate, it could be noticed that at each date of application, the highest effect of growth regulator was obtained at 100 ppm concentration where the average of total dry weight reached 33, 32.76 and 34.63 g/pot for the application of 100 ppm growth regulator 21 days before the first, second and third cut respectively. On the other hand, at each application rate, there was no differences in the dry weight of the plant sprayed with growth regulator either before the first, the second or the third cut.

Finally, for the interaction effect of growth regulator type, application date and rate of application on the total dry weight of the plant (the summation of the three cuts), the data revealed that, the highest dry weight was obtained by the application of 100 ppm IAA 21 days before the first cut or 100 ppm GA_3 21 days before the third cut where the total dry weight reached 35.37 and 35.59 g/pot respectively (Fig. 3a and b).

Fig.3: The effect of various growth regulators treatments on total fresh and dry weight of clover plant





(1): first application date (2) : Second application date
(3): Third application date

The favourable effect of IAA and GA_3 on plant dry weight could be attributed to their effect on increasing leaf area which in turn increased the photosynthetic activity of the whole plant. The increase in leaf area of alfalfa plant due to application 80 ppm IAA was reported by Simko (1984) while Abdel-Aal et al. (1981) attributed the enhancing effect of GA_3 on forage yield to the actual increase in carbon fixation and photosynthesis area of the plant.

4.1.4. The effect on nutrients concentration

4.1.4.1. Nitrogen Percentage :

As indicated in Tables (4-6) nitrogen concentration in clover plant was slightly affected by growth regulator application. Both IAA and GA_3 slightly decreased nitrogen percentage in all cuts. There was no noticeable effect due to type of the growth regulator or to date of application. It was noticed that 100 ppm application resulted the lowest value of nitrogen concentration while 200 ppm application did not cause more decreasing in nitrogen concentration. This result may be due to the dilution effect as a result of cell elongation which is related to low rates of growth regulator.

Data revealed that nitrogen concentration was higher at the second cut in both plants spraying at the first time and that sprayed at the second time. This may be due to the symbiotically nitrogen fixation which increase at this growing stage.

Table (4) Nutrients percentage in clover plant at the first cut :

Rate	Nitrogen			Phosphorus			Potassium			Calcium			Magnesium		
ppm.	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
0	2.50	2.50	2.50	0.285	0.280	0.283	4.40	4.35	4.38	4.0	4.1	4.05	2.79	2.75	2.77
50	2.45	2.50	2.48	0.258	0.278	0.268	4.40	4.30	4.35	3.8	4.0	3.90	2.53	2.57	2.55
100	2.40	2.45	2.43	0.253	0.253	0.253	4.30	4.25	4.28	3.5	3.8	3.65	2.31	2.42	2.36
200	2.45	2.45	2.45	0.243	0.223	0.233	4.20	4.20	4.20	3.4	3.6	3.50	2.24	2.18	2.21
Mean	2.45	2.48	2.47	0.260	0.259	0.260	4.33	4.28	4.30	3.67	3.87	3.77	2.46	2.48	2.47

Table (5) Nutrients Percentages In Clover Plant at the Second Cut :

Spraying Time	Rate ppm.	Nitrogen			Phosphorus			Potassium			Calcium			Magnesium		
		IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
1st	0	2.65	2.60	2.63	0.265	0.278	0.272	4.15	4.00	4.08	3.6	3.5	3.6	2.55	2.60	2.58
	50	2.65	2.55	2.60	0.258	0.265	0.262	3.75	3.80	3.78	3.0	3.1	3.1	2.44	2.53	2.49
	100	2.60	2.50	2.55	0.250	0.260	0.255	3.60	3.80	3.70	2.8	2.9	2.9	2.25	2.47	2.36
	200	2.60	2.55	2.58	0.243	0.249	0.246	3.45	3.35	3.40	2.0	2.3	2.2	2.19	2.30	2.25
	Mean	2.63	2.55	2.59	0.254	0.263	0.259	3.74	3.74	3.74	2.9	3.0	3.0	2.36	2.48	2.42
2nd	0	2.65	2.65	2.65	0.267	0.275	0.271	4.20	4.10	4.15	3.7	3.6	3.7	2.50	2.53	2.52
	50	2.65	2.60	2.63	0.255	0.275	0.265	3.88	3.95	3.92	3.2	3.0	3.1	2.41	2.43	2.42
	100	2.60	2.55	2.58	0.240	0.255	0.248	3.88	3.74	3.81	2.9	2.8	2.9	2.35	2.27	2.31
	200	2.60	2.55	2.58	0.231	0.240	0.236	3.75	3.60	3.68	2.1	2.4	2.3	2.17	2.09	2.13
	Mean	2.63	2.59	2.61	0.248	0.261	0.255	3.93	3.85	3.89	3.0	3.0	3.0	2.36	2.33	2.35
Average	0	2.65	2.63	2.64	0.266	0.277	0.272	4.18	4.05	4.12	3.7	3.6	3.7	2.53	2.57	2.55
	50	2.65	2.58	2.62	0.257	0.270	0.264	3.82	3.88	3.85	3.1	3.1	3.1	2.43	2.48	2.46
	100	2.60	2.53	2.57	0.245	0.258	0.252	3.74	3.77	3.76	2.9	2.9	2.9	2.30	2.37	2.34
	200	2.60	2.55	2.58	0.237	0.245	0.241	3.60	3.48	3.54	2.1	2.4	2.3	2.18	2.20	2.19
	Mean	2.63	2.57	2.60	0.251	0.262	0.257	3.84	3.80	3.82	3.0	3.0	3.0	2.36	2.41	2.39

Table (6) Nutrients Percentages In Clover Plant at the Third Cut :

Spraying Time	Rate ppm.	Nitrogen			Phosphorus			Potassium			Calcium			Magnesium		
		IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
1st	0	2.35	2.40	2.37	0.284	0.285	0.284	4.20	4.25	4.22	3.2	3.0	3.10	2.28	2.25	2.26
	50	2.30	2.35	2.32	0.250	0.253	0.251	3.88	3.95	3.91	3.0	2.8	2.90	2.11	2.17	2.14
	100	2.25	2.25	2.25	0.243	0.233	0.238	3.75	3.84	3.79	2.8	2.6	2.70	1.95	1.75	1.85
	200	2.20	2.20	2.20	0.238	0.225	0.231	3.60	3.48	3.54	2.5	2.5	2.50	1.44	1.51	1.47
	Mean	2.27	2.30	2.28	0.253	0.249	0.251	3.85	3.88	3.86	2.87	2.72	2.80	1.94	1.92	1.93
2nd	0	2.30	2.35	2.32	0.279	0.281	0.980	4.25	4.30	4.27	3.3	3.4	3.35	2.25	2.27	2.26
	50	2.25	2.30	2.27	0.258	0.244	0.251	4.15	3.95	4.05	3.1	3.0	3.05	2.07	2.18	2.12
	100	2.15	2.20	2.17	0.235	0.228	0.231	4.10	3.76	3.93	2.7	2.9	2.80	1.97	2.01	1.99
	200	2.10	2.15	2.12	0.229	0.216	0.220	3.88	3.56	3.72	2.4	2.5	2.45	1.41	1.87	1.64
	Mean	2.20	2.25	2.22	0.250	0.24	0.240	4.10	3.89	3.99	2.80	2.90	2.85	1.92	2.08	2.00
3rd	0	2.35	2.40	2.37	0.285	0.290	0.280	4.20	4.16	4.18	3.2	3.0	3.1	2.20	2.34	2.27
	50	2.30	2.40	2.35	0.268	0.273	0.270	4.00	4.08	4.04	3.0	2.6	2.8	1.77	2.18	1.97
	100	2.30	2.35	2.32	0.209	0.215	0.210	3.80	3.64	3.72	2.6	2.2	2.4	1.57	1.97	1.77
	200	2.30	2.35	2.32	0.205	0.203	0.200	3.50	3.48	3.49	2.1	1.9	2.0	1.17	1.85	1.51
	Mean	2.31	2.37	2.34	0.240	0.240	0.240	3.87	3.84	3.85	2.70	2.40	2.55	1.67	2.08	1.88
Average	0	2.33	2.38	2.35	0.282	0.285	0.280	4.21	4.23	4.22	2.23	3.13	3.18	2.24	2.28	2.26
	50	2.28	2.35	2.31	0.258	0.256	0.250	4.01	3.99	4.00	3.03	2.80	2.90	1.98	2.17	2.07
	100	2.23	2.26	2.24	0.229	0.225	0.226	3.88	3.74	3.81	2.70	2.56	2.60	1.83	1.91	1.87
	200	2.20	2.23	2.21	0.224	0.214	0.217	3.66	3.50	3.58	2.30	2.30	2.30	1.34	1.74	1.54
	Mean	2.26	2.31	2.28	0.250	0.250	0.250	3.94	3.87	3.90	2.82	2.70	2.75	1.85	2.03	1.94

4.1.4.2. Phosphorus Percentage :

Phosphorus concentration in clover plant ranged between 0.203 and 0.285%. Regarding the effect of the two growth regulator types, data indicated that phosphorus concentration was slightly decreased with IAA and GA_3 application, without noticeable difference between their effects. It is noticed that phosphorus concentration was highest at the second cut comparing to the first and third cuts. This may be related to increasing of nitrogen concentration at this growing stage. Tisdale and Nelson (1975) listed various reasons for the effect of nitrogen on phosphorus uptake.

1) Nitrogen increase root growth and foraging capacity for phosphorus.
2) Nitrogen may affect plant metabolism and the ability of roots to absorb phosphorus.
3) Top growth is increased thus increasing need for phosphorus.
4) Nitrogen compounds may have salt effects on phosphorus solubility. Ammonia sources are generally more effective than nitrates.
5) Residual acidity may increase phosphorus availability. In addition, Jones et al. (1991) reported that in a study of 11 flowering plants, the lack of phosphorus was associated with lower nitrogen contents in leaves.

4.1.4.3. Potassium Percentage :

As indicated in Tables (4-6) potassium percentage was decreased with growth regulator application. Data showed no noticeable difference between IAA and GA_3 effects, in this respect. Time of growth regulator application also had no obvious effect. However, growth regulator concentration decreased the potassium percentage throughout the whole growth period. It was decreased with growth regulator concentration increasing up to 200 ppm.

4.1.4.4. Calcium Percentage :

Calcium percentage in clover plant was ranged between 1.9 and 4.1%. Both IAA and GA_3 application decreased calcium percentage in plant. Growth regulator application date had no noticeable effect on calcium percentage, while growth regulator concentration had obviously decreasing effect on calcium percentage throughout the whole growth period.

4.1.4.5. Magnesium Percentage :

Data in Tables (4-6) revealed that magnesium was decreased with growth regulator application. GA_3 application was more effective than IAA application in decreasing magnesium concentration. In this respect, time of application had no noticeable effect, while growth regulator concentrations markedly effected magnesium concentration in clover plant. Magnesium percentage was decreased with increasing growth regulator concentration up to 200 ppm. throughout the whole growth period.

4.1.5. Pigment Concentration :

The effect of various growth regulators treatments on chl. a, chl. b and total chl. as well as carotens concentrations in clover plants are illustrated in Tables (7-9).

Both IAA and GA_3 application for clover plants decreased the concentration of all pigments, while there were slight differences between the effect of the growth regulator types in this respect. This was true throughout the whole growth period.

Concerning the effect of application date, the obtained data revealed that spraying the plant with growth regulator at any of the three cuts reduced all pigments concentrations in plant but there was no obvious differences between the three spraying times.

Increasing growth regulator application rate reduced the concentration of chl. a, chl. b and total chl. as well as carotens. The adverse effect of growth regulator application becomes more pronounced by increasing application rate. However, there were slight differences between the IAA and GA_3 as well as between the three application times in this respect. The decrease in chl. a , chl. b or carotenoids due to IAA or GA_3 application could be attributed to their effects on slowing down the biosynthesis of chlorophyll as reported by Sestake and Ullmann (1960) or to accelerate its breakdown (Artamonov, 1966). Moreover, this effect may be due to an increase in cell division and enlargement which is accompanied by dillution in pigments (Omar et al. 1986).

Table (7) Pigments concentration (mg/100g fresh weight) in clover leaves at the first cut :

Rate ppm.	Chlorophyll a			Chlorophyll b			Total Chlorophyll a + b			Carotines		
	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
0	52.9	52.2	52.6	34.2	34.8	34.5	87.1	87.0	87.1	23.1	23.7	23.4
50	59.1	51.1	55.1	34.0	34.2	34.1	85.9	85.3	85.6	22.7	22.5	22.6
100	50.7	50.0	50.4	33.7	33.9	33.8	84.4	83.9	84.2	21.9	21.0	21.5
200	50.0	49.4	49.7	33.0	33.4	33.2	83.0	82.8	82.9	20.1	19.6	19.9
Mean	53.2	50.7	52.0	33.7	34.1	33.9	84.8	84.8	84.8	22.0	21.7	21.9

Table (8) : Pigments Concentration (mg/100 fresh weight) in clover leaves at the second cut :

Spraying Time	Rate ppm.	Chlorophyll a			Chlorophyll b			Total Chlorophyll a + b			Carotines		
		IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
1st	0	53.8	53.6	53.7	34.4	34.9	34.6	88.2	88.5	88.3	24.2	24.5	24.3
	50	52.7	52.8	52.7	34.0	34.7	34.3	86.7	87.5	87.1	23.6	23.2	23.4
	100	51.9	51.5	51.7	33.7	34.5	34.1	85.6	86.0	85.8	22.5	21.9	22.2
	200	50.5	50.0	50.2	33.3	33.8	33.5	83.8	83.8	83.8	20.9	19.4	20.1
	Mean	52.2	52.0	52.1	33.9	34.5	34.2	86.1	86.5	86.3	22.8	22.3	22.5
2nd	0	54.8	53.0	53.9	34.5	34.8	34.6	89.3	87.8	88.5	24.0	24.4	24.2
	50	52.9	52.0	52.5	34.4	34.5	34.4	87.3	86.5	86.9	22.9	22.1	22.5
	100	51.8	51.0	51.4	34.1	34.1	34.1	85.9	85.1	85.5	21.8	19.8	20.8
	200	49.1	50.4	49.8	33.9	33.2	33.5	83.0	83.6	83.3	19.7	18.1	18.9
	Mean	52.2	51.6	51.9	34.2	34.2	34.2	86.4	85.8	86.1	22.1	21.1	21.6
Average	0	54.3	53.3	53.8	34.4	34.8	34.6	88.7	88.1	88.4	24.1	24.4	24.2
	50	52.8	52.4	52.6	34.2	34.6	34.3	87.0	87.0	87.0	23.2	22.6	22.9
	100	51.9	51.2	51.6	33.9	34.3	34.1	85.7	85.5	85.6	22.1	20.8	21.5
	200	46.2	50.2	48.2	33.6	33.5	33.5	83.4	83.7	83.5	20.3	18.7	19.5
	Mean	51.3	51.7	51.5	34.0	34.3	34.1	86.2	86.1	86.1	22.4	21.6	22.0

Table (9) : Pigments Concentration (mg/100 fresh weight) in Clover Leaves at The Third Cut :

Spraying Time	Rate ppm.	Chlorophyll a			Chlorophyll b			Total Chlorophyll a + b			Carotines		
		IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
1st	0	55.2	55.2	55.2	34.7	35.1	34.9	89.9	90.2	90.1	23.9	24.0	23.9
	50	52.9	53.3	53.1	34.5	34.9	34.7	87.4	88.2	87.8	22.5	22.7	22.6
	100	50.6	51.6	51.1	34.3	34.6	34.4	84.9	86.2	85.5	21.3	21.1	21.2
	200	49.5	50.3	49.9	33.8	34.0	33.9	83.3	84.3	83.8	19.0	19.8	19.4
	Mean	52.1	52.6	52.3	34.3	34.7	34.5	86.4	87.3	86.8	21.7	21.9	21.8
2nd	0	55.2	55.3	55.2	34.8	34.9	34.8	90.0	90.2	90.1	23.7	23.8	23.7
	50	52.1	53.8	53.0	34.6	34.7	34.6	86.6	88.5	87.5	21.9	22.1	22.0
	100	50.0	52.7	51.3	34.5	34.4	34.4	84.5	87.1	85.8	20.7	21.0	20.8
	200	49.4	51.5	50.4	33.9	33.8	33.8	83.3	85.3	84.3	19.4	20.3	19.8
	Mean	51.7	53.3	52.5	34.5	34.5	34.5	86.1	87.8	86.9	21.4	21.8	21.6
3rd	0	54.4	54.7	54.5	35.0	35.0	35.0	89.4	89.7	89.5	23.8	23.9	23.8
	50	51.4	52.8	52.1	34.7	34.8	34.7	86.1	87.6	86.8	22.0	21.8	21.9
	100	49.8	51.2	50.5	34.6	34.6	34.6	84.4	85.8	85.1	20.9	20.5	20.7
	200	49.1	49.8	49.4	33.6	33.9	33.7	82.7	83.7	83.2	19.8	19.4	1.96
	Mean	51.2	52.1	51.6	34.5	34.6	34.5	85.7	86.7	86.2	21.6	21.4	21.5
Average	0	54.9	55.1	55.0	34.8	35.0	34.9	89.8	90.0	89.9	23.8	23.9	23.8
	50	52.1	53.3	52.7	34.6	34.8	34.7	86.7	88.1	87.4	22.1	22.2	22.2
	100	50.1	51.8	51.0	34.5	34.5	34.5	84.6	86.4	85.5	21.0	20.9	20.9
	200	49.3	50.5	49.9	33.8	33.9	33.8	83.1	84.4	83.8	19.4	19.8	19.6
	Mean	51.7	52.7	52.1	34.4	34.6	34.5	86.1	87.3	86.6	21.6	21.7	21.6

4.1.6. Reducing, non-reducing and total soluble sugars concentration :

Spraying the plant with growth regulators induced an increase in reducing, non-reducing and total soluble sugars in clover plant as indicated in Tables (10-12).

It is clear that growth regulator application increased total soluble, reducing and non-reducing sugars. Growth regulator type showed a slight effect where GA_3 application was more effective in increasing total soluble, reducing and non-reducing sugars in most averages. Total soluble, reducing and non-reducing sugars were increased with growth regulator increasing up to 100 ppm, (regardless its type and application time), while further increase in growth regulator concentration reduced its effect.

4.1.7. Protein percentage :

The effect of various growth regulator treatments on the concentration of protein in clover plants was presented in Tables (10-12). There was no obvious difference between the effect of IAA and GA_3 on protein percentage in clover plant. In addition, there was no detectable effect due to time of growth regulator spraying. However, protein percentage was decreased with growth regulator concentration up to 200 ppm with an exception that increasing the rate of growth regulator application to 200 ppm slightly increased the protein percentage at the first cut and the second cut in plants sprayed at the first time.

Table (10) : Sugars, Protein and phenols percentages in clover plant at the first cut :

Rate	Total Soluble Sugars			Reducing Sugars			Non-Reducing Sugars			Protein			Total Phenols		
ppm.	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
0	1.56	1.65	1.61	0.70	0.76	0.73	0.86	0.89	0.88	1563	15.63	15.63	0.49	0.64	0.57
50	3.14	3.16	3.15	0.79	0.93	0.86	2.35	2.23	2.29	15.31	15.63	15.47	0.92	1.22	1.07
100	3.39	3.12	3.26	0.90	1.17	1.04	2.49	1.95	2.22	15.00	15.31	15.16	1.64	1.26	1.45
200	3.39	3.08	3.24	0.96	1.32	1.14	2.43	1.76	2.10	15.31	15.31	15.31	1.76	1.35	1.56
Mean	2.89	2.75	2.82	0.84	1.05	0.95	2.03	1.71	1.87	15.31	15.47	15.39	1.18	1.12	1.16

Table (11) : Sugars, Protein and phenols percentage in clover plant at the second cut :

Spraying Time	Rate ppm.	Total Soluble Sugars			Reducing			Non-Reducing Sugars			Protein			Total Phenols		
		IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
1st	0	1.33	1.29	1.31	071	0.80	0.76	0.62	0.49	0.56	16.56	16.25	16.41	0.58	0.65	0.62
	50	2.39	3.22	2.81	0.89	0.96	0.93	1.50	2.26	1.88	16.56	15.94	16.25	1.48	1.29	1.39
	100	3.16	3.44	3.30	1.33	1.45	1.39	1.38	1.99	1.69	16.25	15.63	15.94	1.76	1.49	1.63
	200	3.10	3.32	3.21	1.11	1.20	1.16	1.99	2.12	2.06	16.25	15.94	16.10	1.65	1.68	1.67
	Mean	2.50	2.82	2.66	1.01	1.10	1.06	1.37	1.72	1.54	16.41	15.94	16.18	1.37	1.28	1.33
2nd	0	2.10	1.46	1.78	0.77	0.79	0.78	1.33	0.67	1.00	16.56	16.56	16.56	0.70	0.91	0.81
	50	3.14	3.32	3.23	1.16	0.90	1.03	1.98	2.42	2.20	16.56	16.25	16.41	1.21	1.05	1.13
	100	3.26	3.69	3.48	1.48	1.12	1.30	1.78	2.57	2.18	16.25	15.94	16.10	1.37	1.28	1.33
	200	3.34	3.62	3.48	1.19	1.17	1.18	2.15	2.45	2.30	16.25	15.94	16.10	1.41	1.20	1.31
	Mean	2.96	3.02	2.99	1.15	1.00	1.07	1.81	2.03	1.92	16.41	16.17	16.29	1.17	1.11	1.14
Average	0	1.72	1.36	1.55	0.74	0.80	0.77	0.98	0.58	0.78	16.56	16.41	16.49	0.64	0.78	0.71
	50	2.77	3.27	3.02	1.03	0.93	0.98	1.74	2.34	2.04	16.56	16.10	16.33	1.35	1.17	1.26
	100	3.21	3.57	3.39	1.41	1.29	1.35	1.58	2.28	1.94	16.25	15.79	16.02	1.57	1.39	1.48
	200	3.22	3.47	3.35	1.15	1.19	1.17	2.07	2.29	2.18	16.25	15.94	16.10	1.53	1.44	1.49
	Mean	2.73	2.92	2.83	1.08	1.05	1.07	1.59	1.88	1.73	16.41	16.06	16.24	1.27	1.19	1.23

4.1.8. Total phenols percentage :

Data in Tables (10-12) revealed that total phenols were increased with both IAA and GA_3 foliar application. This trend was observed throughout the whole growth period.

Concerning the effect of growth regulator application time on phenols concentration in clover plant, the obtained data reflect that there was no obvious differences between the three application dates. Moreover, it was noticed that increasing the application rate of growth regulator (regardless its types and application time) increased its enhancing effect on phenols synthesis.

For the interaction between growth regulator type and application date it was found that for all application dates the highest phenol concentration was obtained by IAA application.

Regarding the interation between growth regulator application date x applicant rate, the obtained data revealed that at each application date the phenols concentrations increased by increasing the application rate.

Respecting the interaction between growth regulator type x application date x application rate, the highest phenols concentration was obtained by the application of 200 ppm IAA at the first cut, while the least value was belonged to the untreated plants at the first cut.

4.2. The effect of spraying soybean plant with various growth regulator types and concentrations at different dates on its growth and quality :

4.2.1. The effect on vegetative growth :

4.2.1.1. Plant height :

Foliar application of GR enhanced the vegetative growth of soybean plants as illustrated in Tables (13) and (14) which represents the response of the plant to application of IAA or GA_3 at different dates (at seedling stage, preflowering stage or presetting stage) with various concentrations (0, 50, 100 or 200 ppm).

Concerning the effect of GR types (IAA or GA_3), it was noticed that at various growth stages, GA_3 was more effective than IAA on increasing plant height, but both promotes growth comparing with untreated plants. In this respect, Audus (1972) stated that GA_3 is one of the most growth regulators having a dramatic effect on stem elongation of plants.

Respecting the effect of spraying date regardless GR types and concentration it was noticed that during the first growth stage, the tallest plants was obtained by spraying the plant with GR during seedling stage where the other treatment was not applied yet. However, at the second growth stage, spraying the plant with GR before flowering was more effective than the other treatment dates. This indicated that the effect of GR on plant growth did not prolonged for long period.

Tabel (13) : Soybean plant growth at the first sample as affected by G.R. application :

Rate	Plant height (Cm)			Fresh weight (g.pot $^{-1}$)			Dry weight (g.pot $^{-1}$)		
ppm.	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
0	35.17	35.83	35.50	8.18	7.51	7.85	1.69	1.67	1.68
50	38.75	55.50	47.13	9.11	8.29	8.70	1.79	1.89	1.84
100	40.60	67.50	54.05	9.69	10.03	9.86	2.04	2.19	2.12
200	36.92	72.47	54.70	8.74	9.26	9.00	1.94	2.03	1.99
Mean	37.86	57.83	47.85	8.93	8.77	8.85	1.87	1.95	1.91

Tabel (14) : Soybean plant growth at the second sample as affected by G.R. application :

Spraying Time	Rate ppm.	Plant height (Cm)			Fresh weight (g.pot^{-1})			Dry weight (g.pot^{-1})		
		IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
1st	0	43.67	45.67	44.67	10.45	9.68	10.07	2.92	2.92	2.92
	50	52.50	62.42	57.46	13.78	10.82	12.30	3.86	3.26	3.56
	100	67.50	90.00	78.75	18.13	14.54	16.34	4.71	4.23	4.47
	200	58.75	76.17	67.46	14.01	13.96	13.99	3.98	4.08	4.03.
	Mean	55.61	68.57	62.09	14.09	12.25	13.17	3.87	3.62	3.75
2nd	0	42.00	45.00	43.50	10.62	10.78	10.70	2.94	2.38	2.66
	50	66.00	83.93	74.97	17.89	18.35	18.12	4.58	4.96	4.77
	100	70.00	98.67	84.55	18.81	19.14	18.98	5.15	5.28	5.22
	200	68.25	92.17	80.21	17.47	17.39	17.43	4.73	5.08	4.91
	Mean	61.67	79.94	70.81	16.20	16.42	16.31	4.35	4.43	4.39
Average	0	42.84	45.34	44.09	10.53	10.23	10.39	2.93	2.65	2.79
	50	59.25	73.18	66.22	15.84	14.59	15.21	4.22	4.11	4.17
	100	68.96	94.34	81.65	18.47	16.84	17.66	4.93	4.76	4.85
	200	63.50	84.17	73.84	15.74	15.68	15.71	4.36	4.58	4.47
	Mean	58.64	74.26	66.45	15.15	14.34	14.74	4.11	4.03	4.07

For the interaction effect of GR type and spraying date, the obtained data revealed that during the first growth stage, the foliar application of GA_3 at seedling stage was more effective than the other treatments, while at the second sample, the tallest plant was obtained by spraying GA_3 before flowering. Moreover, at each spraying date (during seedling and before flowering stages) application of GA_3 was more impressive than IAA which could be attributed to the rapid distruction of IAA in the light which occures even at moderately low intensities (Thimann, 1974), while the effect of GA_3 on stem elongation was closely related to an increase in endogenous IAA content (Follenberg, 1978).

Regarding the effect of growth regulators rate, irrespective of its type and spraying date, it was noticed that during the first growth stage (seedling) the plant height increased by increasing GR concentration up to 100 ppm, however, further increase in GR concentration did not induce any supplementary effect, where the mean of plant height was 54.05 and 54.7 cm at GR concentration of 100 and 200 ppm respectively, while at the next growth stage (flowering stage), the tallest plant was obtained by foliar application of 100 ppm GR where the plant height reached 81.65 cm (as an average across GR type and time of application) but increasing the concentration of GR up to 200 ppm reduced its promotive effect as the plant height was 73.8 cm, however it is still taller than the untreated plants which was 55.7 cm only.

The interaction effect of GR type x application rate revealed that during seedling stage the enhancing effect of GA_3 increased by increasing its concentration up to 200 ppm, while for IAA this ameliorating effect was detected up to 100 ppm concentration but increasing the IAA concentration up to 200 ppm reduced its effectiveness. The tallest plant during this stage was obtained by spraying the plant with 200 ppm GA_3.

For the interaction between spraying date and GR concentration regardless its type, the obtained data illustrated that at each spraying date, increasing GR concentration increased plant height but during the flowering stage the foliar application of 100 ppm GR was more effective than 200 ppm application rate. Moreover during this stage at each GR application rate, foliar application preflowering induced the highest effect on plant growth compared with the application during seedling stage and the untreated plants.

Finally, the data of the interaction between GR types x spraying date x GR concentration revealed that during seedling stage, the tallest plant was obtained by spraying the plant with 200 GA_3 during this stage, while at the second sample (during flowering stage) the preflowering foliar application of IAA or GA_3 was more effective than their application during seedling stage. This was true for each IAA and GA_3 application rate. However, GA_3 application was more effective than IAA application which could be observed at the two spraying dates and each application rate of the two growth regulators. The superior effect on plant height was obtained by spraying the plant

with 100 ppm GA_3 preflowering, while increasing application rate up to 200 ppm reduced its enhancing effect.

The significant increase of soybean growth as a result of GA_3 application may revealed the important role of GA_3 in stimulating cell division and cell elongation. In this respect, Delaguardia and Benlloch (1980) reported that GA_3 must act simultaneously on several factors related to cell growth, i.e. cell extensibility, memberane pereability, enzymatic activity and variation in osmotic potential. In addition, Montague (1995) found that GA_3 promote growth (cell expansion and cell wall synthesis) in plants.

4.2.1.2. Fresh and dry weights :

The effect of spraying plants with various concentrations of IAA or GA_3 at different growth stage on plant fresh weight throughout the whole growth period was illustrated in Table (13) and (14). The data presented in these tables revealed that during the first growth stage, the plants responded to both IAA and GA_3 in the same manner, where the fresh weight of the plants sprayed with IAA and GA_3 were 8.9 and 8.7 gm/plant respectively while the dry weights were 1.87 and 1.95 g/plant respectively (as an average across their concentration and spraying time) , while during the second growth stage the effect of IAA on increasing plant fresh and dry weight were slightly higher than the effect of GA_3 where the plant fresh weight reached 15.6 and 14.3 gm/plant and dry weights were 4.11 and 4.03 g/plant for IAA and GA_3 respectively.

This could be attributed to the effect of IAA and GA_3 on increasing enzymatic activity and osmotic potential causing an increase in water and element absorption and consequently plant fresh weight an dry matter accumulation.

Concerning the effect of spraying date, irrespective of GR types and concentrations, it was found that at the first sample the plants were recieved GR during seedling stage only, while the other two application dates were not come yet. So the fresh weight of the plants sprayed with GR during seedling stage was slightly higher than that of untreated plants. However, during the second growth stage, the effect of spraying date on plant fresh weight was pronounced, where the fresh weight of the plants sprayed with GR preflowering was higher than those sprayed with GR during seedling stage by about 23.8% while the increase in dry weight reached 17%.

This was in accordance with El-Gamal (1985) who stated that the effect of GA_3 in dependent on which age the plants is treated and that treatment in early growth phases gives the detrimental effects.

For the interaction effect of GR types and spraying date, it was noticed that at the first sample this interaction was not detected where the plants recieved GR at one spraying date only. However, during the second sample, for both regulators (IAA and GA_3) the preflowering foliar application was more effective than the application during seedling time.

Regarding the effect of GR application rate, the data revealed that, regardless GR types and application date, increasing the

concentration of GR to 100 ppm induced appreciable increase in plant fresh and dry weights particularly during the second growth period (flowering stage), but further increase in GR concentration up to 200 ppm reduced its effectivness, where the fresh and dry weights of the plant sprayed with 200 ppm GR was slightly lower than the fresh weight of the plants recieved 100 ppm GR which was true during the whole growth period. This was in accordance with the finding of Stenlid (1976) and Rashad and Ahmed (1996).

For the interaction between growth regulator type and rate of application, it could be noticed that for each growth regulator, the highest fresh and dry weight was obtained at 100 ppm application rate, while at each application rate, there was slight differences between the effect of IAA and GA_3 on plant fresh and dry weight during the whole growth period. In this connection Rashad and Ahmed (1996) reported that the high values of neutral auxin activity were recorded by the plants treated with the lowest rate of GA_3.

Concerning the interaction between application date and rate the statistical analysis revealed that at each application rate, the highest fresh and dry weight was obtained by spraying the plant with growth regulator before flowering.

Finally the interaction between growth regulator type X application date X application rate, illustrated that during seedling stage the best treatment was the application of 100 ppm GA_3 during this stage, while at the second sample, the highest fresh and dry

weights were obtained by spraying the plant with 100 ppm IAA or GA_3 at preflowering.

The enhancing effect of IAA and GA_3 on increasing fresh and dry weights of the plant could be attributed to any of the following possibilities; (1) photosynthetic activity per unit leaf area is increased; (2) the activity per unit leaf area remains unchanged but owing to the increase in leaf area and leaves number by the treatment (induced as a result of increasing cell elongation and division) or (3) the amount of carbon dioxide fixed by the whole plant as well as photosynthetic activity increase. The last hypothesis was in accordance with the finding of Farag et al. (1987). Also, increase in photosynthetic activity induced by GA_3 application was pointed out by Marcelle and Oben (1973) and Sankhla and Huber (1974 and 1975).

Moreover, the effect of GA_3 application on metabolic processes in the plant was reported by Leopold and Kriedeman (1975) who found that GA_3 promotes the synthesis of new enzymes which is associated with stimulations of RNA synthesis.

4.2.2. The effect on nutrients concentration :

4.2.2.1. Nitrogen Percentage :

It is clear from data in Tables (15-17) that nitrogen percentage was decreased with growth regulator application throughout the whole growth period. Growth regulator type had no respectable differences in this respect, while plant growth stages showed different averages of nitrogen concentration in soybean plant, the major effect of growth regulators was due to their concentration.

Table (15) : Nutrients percentages in soybean plant at the first sample :

Rate	Nitrogen			Phosphorus			Potassium			Calcium			Magnesium		
ppm.	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
0	2.35	2.40	2.38	0.284	0.261	0.273	2.78	2.88	2.83	4.0	4.0	4.0	4.08	4.19	4.13
50	2.30	2.30	2.30	0.235	0.252	0.244	2.73	2.60	2.66	4.0	3.8	3.9	3.94	4.00	3.97
100	2.25	2.20	2.22	0.224	0.248	0.236	2.60	2.45	2.52	3.8	3.6	3.7	3.72	3.81	3.76
200	2.20	2.20	2.20	0.217	0.222	0.220	2.45	2.30	2.37	3.7	3.5	3.6	3.56	3.62	3.59
Mean	2.27	2.27	2.27	0.231	0.245	0.238	2.64	2.55	2.59	3.8	3.7	3.8	3.82	3.91	3.86

Table (16) : Nutrients Percentages In Soybean Plant at the Second Sample :

Spraying Time	Rate ppm.	Nitrogen			Phosphorus			Potassium			Calcium			Magnesium		
		IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
1st	0	1.95	1.90	1.92	0.250	0.255	0.253	2.45	2.43	2.44	3.8	3.9	3.85	2.86	3.03	2.94
	50	1.90	1.80	1.85	0.235	0.238	0.237	2.33	2.23	2.28	3.4	3.3	3.35	2.60	2.82	2.71
	100	1.85	1.75	1.80	0.219	0.228	0.224	2.28	2.23	2.25	3.0	2.8	2.9	2.33	2.51	2.42
	200	1.75	1.65	1.70	0.210	0.218	0.214	2.23	2.15	2.19	2.8	2.7	2.75	2.19	2.22	2.2
	Mean	1.86	1.77	1.82	0.229	0.235	0.232	2.32	2.26	2.29	3.25	3.17	3.21	2.49	2.64	2.56
2nd	0	1.90	1.95	1.93	0.253	0.255	0.254	2.43	2.45	2.44	3.9	3.8	3.85	2.92	2.88	2.9
	50	1.85	1.90	1.88	0.243	0.248	0.246	2.38	2.23	2.3	3.6	3.5	3.55	2.40	2.52	2.46
	100	1.85	1.80	1.83	0.215	0.225	0.220	2.38	2.18	2.28	3.3	3.5	3.4	2.28	2.37	2.32
	200	1.75	1.80	1.73	0.203	0.213	0.208	2.25	2.00	2.12	2.9	3.0	2.95	2.33	2.29	2.31
	Mean	1.83	1.86	1.85	0.229	0.235	0.232	2.36	2.21	2.28	3.42	3.45	3.43	2.48	2.51	2.49
Average	0	1.92	1.92	1.92	0.252	0.255	0.254	2.44	2.44	2.44	3.85	3.85	3.85	2.89	2.95	2.92
	50	1.87	1.85	1.86	0.239	0.243	0.242	2.35	2.23	2.29	3.5	3.4	3.45	2.5	2.67	2.58
	100	1.85	1.77	1.81	0.217	0.227	0.222	2.33	2.20	2.26	3.15	3.15	3.15	2.3	2.44	2.37
	200	1.75	1.72	1.74	0.207	0.216	0.211	2.24	2.07	2.15	2.85	2.85	2.85	2.26	2.25	2.25
	Mean	1.84	1.81	1.83	0.229	0.235	0.232	2.34	2.23	2.28	3.33	3.31	3.32	2.48	2.57	2.53

Table (17) : Nutrients Percentages In Soybean Seeds :

Spraying Time	Rate ppm.	Nitrogen			Phosphorus			Potassium			Calcium			Magnesium		
		IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
1st	0	450	4.45	4.47	0.445	0.450	0.447	2.28	2.25	2.26	2.5	2.6	2.55	1.28	1.30	1.29
	50	4.45	4.35	4.4	0.433	0.442	0.437	2.28	2.14	2.21	2.4	2.2	2.3	1.28	1.29	1.28
	100	4.40	4.30	4.35	0.418	0.415	0.416	2.28	2.08	2.18	2.0	2.0	2.0	1.08	1.17	1.12
	200	4.35	4.30	4.32	0.405	0.408	0.406	2.15	2.03	2.09	1.5	1.7	1.6	1.04	1.14	1.09
	Mean	4.42	4.35	4.38	0.425	0.428	0.426	2.24	2.12	2.18	2.1	2.12	2.1	1.17	1.22	1.19
2nd	0	4.45	4.50	4.47	0.448	0.453	0.45	2.27	2.25	2.26	2.5	2.4	2.45	1.26	1.27	1.26
	50	4.40	4.45	4.42	0.435	0.448	0.44	2.25	2.13	2.19	2.0	2.2	2.1	1.20	1.14	1.17
	100	4.40	4.35	4.37	0.413	0.435	0.42	2.18	2.02	2.1	2.0	1.9	1.95	1.14	1.05	1.09
	200	4.35	4.30	4.32	0.404	0.408	0.406	2.15	1.95	2.05	1.5	1.7	1.6	1.08	0.98	1.03
	Mean	4.4	4.4	4.4	0.425	0.436	0.43	2.21	2.08	2.14	2.0	2.05	2.02	1.17	1.11	1.14
3rd	0	4.50	4.40	4.45	0.450	0.448	0.449	2.28	2.21	2.24	2.4	2.5	2.45	1.27	1.30	1.28
	50	4.50	4.35	4.42	0.438	0.439	0.438	2.23	2.10	2.16	2.3	2.1	2.2	1.13	1.27	1.2
	100	4.45	4.30	4.37	0.423	0.413	0.418	2.13	1.98	2.05	2.0	1.9	1.95	1.10	1.15	1.12
	200	4.45	4.25	4.35	0.398	0.393	0.395	2.05	1.80	1.92	1.8	1.7	1.75	1.05	1.00	1.02
	Mean	4.47	4.32	4.39	0.427	0.423	0.425	2.17	2.02	2.09	2.12	2.05	2.08	1.13	1.18	1.15
Average	0	4.48	4.45	4.46	0447	0.45	0.448	2.27	2.23	2.25	2.4	2.5	2.48	1.27	1.29	1.27
	50	4.45	4.38	4.41	0.435	0.443	0.438	2.25	2.12	2.18	2.23	2.1	2.2	1.2	1.23	1.21
	100	4.41	4.31	4.36	0.418	0.421	0.418	2.19	2.02	2.11	2.0	1.9	1.96	1.1	1.12	1.11
	200	4.38	4.28	4.33	0.402	0403	0.402	2.11	1.92	2.02	1.6	1.7	1.65	1.05	1.04	1.04
	Mean	4.43	4.35	4.39	0.425	0.429	0.427	2.2	2.07	2.13	2.07	2.07	2.07	1.15	1.17	1.16

Nitrogen percentage was decreased with increasing growth regulator concentration up to 200 ppm. This trend was true throughout the whole growth period.

4.2.2.2. Phosphorus Percentage :

Data in Tables (15-17) revealed that phosphorus percentage was markedly effected with growth regulator application. IAA had a pronounced effect in decreasing phosphorus percentage in soybean plant. Phosphorus percentage slightly decreased with plant growth progress. However, the growth regulator concentration was the most effective factor that decreasing phosphorus concentration in soybean plant throughout the whole growth period.

4.2.2.3. Potassium Percentage :

As mentioned above for phosphorus percentage, potassium percentage in soybean plant was markedly decreased with growth regulator application. GA_3 application was more effective than IAA application in decreasing potassium percentage in soybean plant. Time of growth regulator application had no obvious effect on potassium concentration. However, growth regulator concentration was the most effective factor in this respect. Potassium percentage was decreased markedly with both IAA and GA_3 concentrations up to 200 ppm throughout the whole growth period.

4.2.2.4. Calcium Percentage :

It is clear from data listed in Tables (15-17) that calcium percentage had affected by growth regulator application. It is noticed that calcium percentage was decreased with soybean plant

development. Growth regulator type did not show different effects on calcium concentration in soybean plant. However, calcium percentage decreased with growth regulator concentration up to 200 ppm throughout the whole growth period.

4.2.2.5. Magnesium Percentage :

Data in Tables (15-17) revealed that magnesium percentage was also affected by growth regulator treatment. IAA application was slightly effective than GA_3 application in decreasing magnesium percentage in soybean plant. Time of application had no noticeable effect in this respect. Growth regulator concentration was the most effective factor that decreasing magnesium concentration, which was decreased with growth regulator concentration up to 200 ppm. It is noticed that magnesium concentration was decreased with soybean plant development.

4.2.3. The effect on pigments concentration :

The effect of various growth regulators treatments on chlorophyll a, chlorophyll b and total chlorophyll as well as carotens concentrations in soybean plant are presented in Tables (18) and (19).

It could be noticed from the data presented in these tables that the application of either IAA or GA_3 to soybean plants decreased the concentration of all pigments in leaf (chl. a, chl. b, total chl. and carotens), while there were slight differences between the effect of the two growth regulator types in this respect. This was true throughout the whole growth period.

Table (18) : Pigments concentration (mg/100g fresh weight) in soybean leaves at the first sample :

Rate	Chlorophyll a			Chlorophyll b			Total Chlorophyll a + b			Carotines		
ppm.	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
0	76.6	75.6	76.1	41.6	42.1	41.8	118.2	117.7	117.9	37.1	36.9	37.0
50	74.9	73.0	73.9	39.0	39.2	39.1	113.9	112.2	113.0	35.7	35.4	35.5
100	66.0	70.1	68.0	37.9	38.4	38.0	103.9	108.5	106.2	33.9	34.1	34.0
200	64.3	67.7	66.0	36.2	36.7	36.4	100.5	104.4	102.4	31.8	32.1	31.9
Mean	70.5	71.6	71.0	38.7	39.1	38.9	109.1	110.7	109.9	34.6	34.6	34.6

Table (19) : Pigments Concentration (mg/100 fresh weight) in soybean leaves at the second sample :

Spraying Time	Rate ppm.	Chlorophyll a			Chlorophyll b			Total Chlorophyll a + b			Carotines		
		IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
1st	0	74.9	73.2	74.0	42.9	43.4	43.1	117.8	116.6	117.2	39.4	39.1	39.2
	50	71.6	71.0	71.3	40.4	41.1	40.7	112.0	112.1	112.0	38.7	37.3	38.0
	100	67.5	67.0	67.2	38.5	40.0	39.0	106.0	106.9	106.4	36.4	35.8	36.1
	200	65.0	63.0	64.0	37.1	38.7	37.9	102.1	101.9	102.0	34.2	34.9	34.5
	Mean	69.7	68.5	69.1	39.7	40.8	40.2	109.5	109.4	109.4	37.2	36.8	37.0
2nd	0	74.4	73.8	74.1	43.3	43.1	43.2	117.7	116.9	117.3	39.2	39.4	39.3
	50	69.2	71.5	70.3	42.2	41.9	42.0	111.4	113.4	112.4	37.9	38.2	38.1
	100	66.7	68.2	67.4	41.4	40.8	41.1	108.1	109.0	108.5	36.6	37.5	37.1
	200	63.5	64.1	63.8	39.9	38.8	39.3	103.4	102.9	103.1	33.8	35.1	34.4
	Mean	68.5	69.4	68.9	41.7	41.2	41.4	110.2	110.6	110.4	36.9	37.6	37.2
Average	0	74.6	73.5	74.1	43.1	43.2	43.1	117.7	116.7	117.2	39.3	39.2	39.2
	50	70.4	71.2	70.8	41.3	41.5	41.3	111.7	119.7	112.2	38.3	37.7	38.0
	100	67.1	67.6	67.3	39.9	40.4	40.1	107.0	107.9	107.4	36.5	36.6	36.5
	200	64.2	63.5	63.9	38.5	38.7	38.6	102.7	102.4	102.5	34.0	35.0	34.5
	Mean	69.0	68.9	69.0	40.7	40.9	40.8	111.2	109.9	110.0	37.0	37.1	37.1

Concerning the effect of application time, the obtained data revealed that spraying the plant with growth regulators either during seedling stage or preflowering reduced all pigments concentrations in the leaves, but there was no obvious differences between the two spraying times.

Regarding the effect of application rate, it is clear that increasing growth regulator application rate reduced the concentration of chl. a, chl. b and total chl. as well as carotens.

For the interaction between growth regulator type x application date x application rate, it could be noticed that spraying the plant with IAA or GA_3 either during seedling stage or preflowering reduced the concentration of all pigments in the leaves (chl. a, chl. b and total chl. as well as carotens) during the whole growth period. The adverse effect of growth regulator application becomes more pronounced by increasing application rate. However, there were slight differences between the IAA and GA_3 as well as between the two application dates, in this respect.

The decrease in chl. a , chl. b or carotenoids due to IAA or GA_3 application could be attributed to their effects on slowing down the biosynthesis of chlorophyll as reported by Sestake and Ullmann (1960) or to accelerate its breakdown (Artamonov, 1966). Moreover, this effect may be due to an increase in cell division and enlargement which is accompanied by dilution in pigments (Omar et al. 1986).

4.2.4. Reducing, non-reducing and total soluble sugars concentration :

Spraying the plant with growth regulators induced an increase in reducing, non-reducing and total soluble sugars in soybean plant as illustrated in Tables (20) and (21).

The data presented in these tables reflect that at seedling stage the application of GA_3 was more effective than IAA in increasing soluble sugars in soybean plant, while at flowering stage, the enhancing effect of IAA on soluble sugars was similar to that obtained by GA_3 application (regardless its application date and rate).

Concerning the effect of growth regulator application date (irrespective of its type and concentration), it was noticed that spraying the plant with growth regulator during seedling stage was more efficient in increasing soluble sugars than preflowering application of growth regulator.

However, the interaction between growth regulator type and application date revealed that at seedling stage, the effect of GA_3 application during this stage increased soluble sugars in plants surpass that induced by IAA application. However, at the subsequent growth period, it was noticed that at the first application date, IAA was more effective than GA_3 in increasing soluble sugars and its fractions in the plant while the reverse was true for the second application date. Moreover, the application of IAA during seedling stage was more efficient than preflowering application where the reducing sugars was 1.2 and 1.8; the non-reducing sugars were 2.2

Table (20) : Sugars, Protein and phenols percentage in soybean plant at the first sample :

Rate	Total Soluble Sugars			Reducing Sugars			Non-Reducing Sugars			Protein			Total Phenols		
ppm.	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
0	1.61	1.56	1.59	0.84	0.81	0.83	0.77	0.75	0.76	14.69	15.00	14.85	0.63	0.76	0.70
50	2.14	3.38	2.76	1.49	1.49	1.49	0.65	1.89	1.27	14.38	14.38	14.38	0.92	1.04	0.98
100	3.61	3.61	3.61	1.58	1.73	1.66	2.03	1.88	1.96	14.06	13.75	13.91	1.33	1.25	1.29
200	3.23	3.23	3.23	1.51	1.63	1.57	1.72	2.72	2.22	13.75	13.75	13.75	1.48	1.20	1.34
Mean	2.65	2.95	2.80	1.36	1.42	1.39	1.30	1.81	1.55	14.22	14.22	14.22	1.09	1.06	1.08

Table (21) : Sugars, Protein and phenols percentage in soybean plant at the second sample :

Spraying Time	Rate ppm.	Total Soluble Sugars			Reducing Sugars			Non-Reducing Sugars			Protein			Total Phenols		
		IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
1st	0	2.06	1.94	2.00	0.74	0.83	0.78	1.32	1.11	1.2	12.19	11.88	12.04	0.68	0.45	0.56
	50	3.28	2.58	2.93	1.04	1.09	1.06	2.24	1.49	1.86	1188	11.25	11.57	1.31	0.99	1.15
	100	4.10	3.62	3.86	1.42	1.32	1.37	2.68	2.30	2.49	11.56	10.94	11.25	1.41	1.31	1.36
	200	4.27	3.02	3.65	1.62	1.47	1.54	2.65	1.55	2.1	10.94	10.31	10.63	1.51	1.47	1.49
	Mean	3.43	2.79	3.11	1.21	1.18	1.19	2.22	1.61	1.9	11.64	11.10	11.37	1.23	1.06	1.14
2nd	0	1.66	2.13	1.90	0.65	1.01	0.83	1.01	1.12	1.06	11.88	12.19	12.04	0.84	0.94	0.89
	50	2.19	3.34	2.80	1.04	1.27	1.15	1.15	2.07	1.61	11.56	11.88	11.72	1.21	1.26	1.23
	100	3.58	4.34	3.96	1.47	1.56	1.5	2.11	2.78	2.44	11.56	11.25	11.41	1.31	1.31	1.31
	200	3.35	3.50	3.43	1.54	1.53	1.53	1.81	1.97	1.89	10.94	11.25	11.10	1.41	1.41	1.41
	Mean	2.70	3.33	3.02	1.18	1.34	1.26	1.52	1.99	1.75	11.49	11.64	11.57	1.19	1.23	1.21
	0	1.86	2.04	1.95	0.70	0.92	0.81	1.17	1.12	1.14	12.04	12.04	12.04	0.76	0.70	0.73
	50	2.74	2.96	2.85	1.04	1.18	1.11	1.70	1.78	1.74	11.72	11.57	11.65	1.26	1.13	1.19
	100	3.84	3.98	3.91	1.54	1.44	1.44	2.40	2.54	2.47	11.56	11.10	11.33	1.36	1.31	1.33
	200	3.81	3.26	3.54	1.58	1.5	1.54	2.23	1.76	1.99	10.94	10.78	10.86	1.46	1.44	1.45
	Mean	3.07	3.06	3.06	1.20	1.26	1.23	1.88	1.80	1.84	11.57	11.37	11.47	1.21	1.15	1.18

and 1.5 while the total soluble sugars were 3.43 and 2.7% for the application of IAA during seedling and preflowering stages respectively. This revealed that the effect of IAA was more prolonged than the effect of GA_3 in this respect.

Respecting the effect of growth regulator application rate, the data revealed that increasing application rate of growth regulator up to 100 ppm (regardless its type and application date) increased the concentration of soluble sugars and its fractions, while further increase in growth regulator concentration reduced its effect, with the exception of the concentration of non-reducing sugars during seedling stage which increased by increasing growth regulator application up to 200 ppm (non-reducing sugars concentration reached 2.22).

For the interaction effect of growth regulator type x application time x application rate, it was observed that, during seedling stage, the highest non-reducing sugars concentration was induced by spraying the plant during this period by 100 ppm IAA or 200 ppm GA_3 , where non-reducing sugars concentrations were 2.03 and 2.72 respectively, while the highest reducing sugars (1.73) was obtained by the application of 100 ppm GA_3.

For the total soluble sugars, the highest concentration (3.61) was obtained by the application of 100 ppm IAA or GA_3. Moreover at the second growth stage (preflowering) the highest reducing sugar concentration (1.56), non-reducing sugars concentration (2.78) and consequently total soluble sugars concentration (4.39) were obtained

by application of 100 ppm GA_3. These results were in agreement with those obtained by El-Assioty (1983) and Farag et al. (1987).

The enhancement of sugar production due to spraying the plants with GA_3 or IAA may be attributed to their stimulating effect on amylase activity which causes the transformation of carbohydrate to soluble sugars (Broughton et al., 1970 on pea). Moreover the effect of GA_3 and IAA application on increasing cell division and elongation which causes an increases in leaf area and photosynthetic activity, consequently the accumulation of soluble sugars increases.

The increase in sugars carbohydrates in plants due to growth regulators treatments were recorded also by Fahym et al. (1983) and Nabila and Nagwan (1996).

4.2.5. Protein Percentag :

Data listed in Tables (20) and (21) showed that protein concentration was decreased with growth regulator application.

Concerning the effect of growth regulator application date the obtained data reflect that there was no obvious differences between the two application dates. However the application of growth regulator either during seedling stage or preflowering stage decreased the concentration of protein.

Moreover, it was noticed that increasing the application rate of growth regulator (regardless its type and application date) increased its effectiveness in decreasing protein percentage.

For the interaction between growth regulator type and application date, it was found that for the first application date, the

least protein concentration was obtained by both IAA and GA_3 application while for the second application date, the least protein concentration was obtained by GA_3 , application.

4.2.6. Total Phenols Concentration :

The effect of various growth regulator treatments on the concentration of total phenols was presented in Tables (20) and (21).

It was found that both IAA and GA_3 foliar application increased the concentration of phenols compared to the untreated plants. This effect was observed throughout the whole growth period.

Concerning the effect of growth application date on phenols concentration, the obtained data reflect that there was no obvious differences between the two application dates. However, the application of growth regulator either during seedling stage or preflowering stage increased the concentration of phenols.

Moreover, it was noticed that increasing the application rate of growth regulator (regardless its type and application date) increased its enhancing effect on phenols synthesis.

For the interaction between growth regulator type and application date, it was found that for the first application date the highest phenol concentration was obtained by IAA application while for the second application date, the GA_3 application was more efficient than IAA application.

4.2.7. The effect of growth regulators on yield and yield parameters :

Soybean yield depend mainly on three yield parameters : number of pods/plant, number of seeds/pod and the seed index (the 100 seed weight).

The effect of spraying soybean plant with various concentration of IAA or GA_3 at three different stages (seedling, preflowering and presetting) on yield and yield components were presented in Tables (22) and (23).

It was noticed from these data that both IAA and GA_3 were effective in increasing pods fresh and dry weights, seed yield, number of pods/plant, number of seeds/pod as well as seed index (weight of 100 seeds), however GA_3 was more efficient than IAA in this respect.

Concerning the effect of application date, the data revealed that regardless growth regulator type and concentration, its application preflowering produced the highest yield compared with the other two application dates, where the relative increases in pods fresh weight reached 8.9, 18.6 and 13.9% and the relative increases in seed yield were 6.6, 11.5 and 3.1% for the first, second and the third application date respectively. However, the number of pods/plant was higher in plants sprayed with growth regulator during seedling stage compared with other two spraying dates, where the relative increases in pods number were 11.7, 10.17 and 3.8% for the first, second and third application date respectively. Moreover, the number of seeds/pod was not affected by the appliction date as the relative increase in seed

Tabel (22) : Some Soybean Yield Components :

Spraying Time	Rate ppm.	Number of Pods Per Plant			Number of Seeds Per Pod			Weight of 100 Seeds		
		IAA	GA	Meant	IAA	GA	Meant	IAA	GA	Meant
1st	0	11.42	11.58	11.50	2.21	2.27	2.24	11.111	11.61	11.36
	50	13.00	13.92	13.46	2.29	2.32	2.31	11.69	12.07	11.88
	100	13.75	14.42	14.09	2.91	2.76	2.84	11.94	12.47	12.21
	200	12.67	12.00	12.34	2.62	2.59	2.61	11.21	11.64	11.43
	Mean	12.71	12.98	12.85	2.51	2.49	2.50	11.49	11.95	11.72
2nd	0	11.75	11.83	11.79	2.26	2.28	2.27	11.61	11.06	11.34
	50	13.17	12.17	12.67	2.30	2.42	2.36	11.94	11.91	11.93
	100	13.75	13.25	13.50	2.88	2.83	2.86	12.35	12.91	12.63
	200	13.42	12.00	12.71	2.52	2.60	2.56	11.79	11.62	11.71
	Mean	13.02	12.31	12.67	2.49	2.53	2.50	11.92	11.87	11.90
3rd	0	11.33	11.17	11.25	2.24	2.25	2.25	11.30	11.11	11.21
	50	11.50	12.92	12.21	2.55	2.41	2.48	11.35	11.89	11.62
	100	12.25	12.67	12.46	2.68	2.73	2.71	11.81	12.23	12.02
	200	11.83	11.83	11.83	2.39	2.48	2.44	10.82	12.09	11.46
	Mean	11.73	12.15	11.94	2.47	2.47	2.47	11.32	11.83	11.58
Average	0	11.50	11.53	11.52	2.23	2.27	2.25	11.34	11.26	11.30
	50	12.56	13.00	12.78	2.38	2.38	2.38	11.66	11.96	11.81
	100	13.25	13.45	13.35	2.82	2.77	2.80	12.03	12.54	12.29
	200	12.64	11.94	12.29	2.51	2.56	2.54	11.27	11.78	11.53
	Mean	12.49	12.48	12.49	2.49	2.50	2.50	11.58	11.88	11.73

number reached 11.5% for all application dates. It is worth to mention here that seed index was slightly affected by growth regulator application date where the relative increases in the weight of 100 seeds were 3.16, 4.7 and 1.9% for the first, second and third application date.

Regarding the effect of growth regulator application rate, regardless its type and application date, it could be observed that the fresh and dry weights of pods as well as seed yield, number of pods/plant, number of seeds/pod and weight of 100 seeds were increased by increasing growth regulator application rate up to 100 ppm. On the other hand, further increase to 200 ppm reduced its enhancing effect which could be partially due to the lower promoting effect on dry matter accumulation induced by the increase in growth regulator rate up to 200 ppm. The same trend was recorded also by Fouda and Salama (1998).

For the interaction between growth regulator type and application date, it was noticed that at each application date there was little differences between the two growth regulator type concerning their effects on yield and yield parameters. However, for both IAA and GA_3 it was found that the most suitable date for application was the preflowering stage which gives the highest fresh and dry weight of pods, the highest seed yield, number of pods/plant and number of seeds/pod. However, there was slight differences between various growth regulator treatments concerning their effects on seed index.

Respecting the effect of growth regulator type x application rate, the data revealed that the highest pods fresh weight, seed yield, number of pods/plant, number of seeds/pod and weight of 100 seeds were obtained by the application of 100 ppm of either IAA or GA_3 (regardless application date). This result confirmed those reported by Ibrahim et al. (1990).

Irrespective of growth regulator type, it was found that at each application date, the highest plant response was obtained at 100 ppm growth regulator concentration.

Generally, the interaction between growth regulator type x application date x application rate, illustrated that the highest fresh and dry weight of pods, highest seed yield and weight of 100 seeds were obtained by the preflowering application of 100 ppm GA_3. However, the highest number of pods/plant was obtained by the application of 100 ppm GA_3 during seedling stage. But the highest seeds number/pod was obtained by the preflowering application of 100 ppm IAA or GA_3.

It could be concluded from the previous discussions that application of 100 ppm GA_3 during seedling stage encourage pod setting. This was in accordance with the finding of El-Waziry and Abo El-Lil (1978) who showed that GA_3 at 100 ppm caused a significant increase in number of flowers and pods per plant. However, the application of 100 ppm GA_3 preflowering promote seed setting and filling.

The improving of seed production may be attibuted to the action of GA_3 on increasing enzymatic activity and metabolism which confirmed by the finding of Koriesh (1989), Hassan et al. (1991) and Eid and Iman (1995). However, the effectiveness of low application level (100 ppm) on increasing seed yield more than the high level (200 ppm) may be due to an increase in flowering period (Castro and Vello, 1983), the highest promoting effect obtained by the preflowering application date compared with the other two application dates confirme this hypothesis. In this regards, Naylor (1984) reported that GA_3 causes an increase in flower initiation indirectly through the production of other flower promoting factors.

In addition, it can be suggested that the increase in total sugar concentration which obtained by IAA and GA_3 application increased the amounts of sugars translocated from the leaves (source) to flower bud (sink), which may implicated in the induction of early flower initiation. In this respect, Chen et al. (1994) indicated that the content of sucrose, glucose and fructose of the inflorenscence increased significantly above the control in the plants treated with GA_3.

4.2.8. The effect of growth regulators on seed quality :

4.2.8.1. Sugars percentage :

The data presented in Table (24) recorded the promoting effect of IAA and GA_3 application on increasing the sugars synthesis. GA_3 was more effective in increasing reducing sugars, while IAA was much effective in condensation of mono-saccharides to non-reducing sugars.

Table (24) : Sugars, Protein and phenols percentage in Soybean Seeds :

Spraying Time	Rate ppm.	Total Soluble Sugars			Reducing Sugars			Non-Reducing Sugars			Protein			Total Phenols		
		IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean	IAA	GA	Mean
1st	0	1.77	1.52	1.64	0.78	0.83	0.8	0.99	0.69	0.84	28.13	27.81	27.97	0.51	0.56	0.53
	50	2.91	2.34	2.62	1.42	1.29	1.35	1.49	1.05	1.27	27.81	27.19	27.50	1.09	1.17	1.13
	100	4.22	3.43	2.82	1.80	1.62	1.71	2.42	1.81	2.1	27.50	26.88	27.19	1.48	1.49	1.48
	200	3.97	3.36	3.66	1.29	1.50	1.39	2.68	1.86	2.27	27.19	26.88	27.04	1.47	1.49	1.48
	Mean	3.22	2.66	2.93	1.32	1.31	1.31	1.90	1.35	1.62	27.70	27.19	27.44	1.14	1.18	1.16
2nd	0	1.56	1.80	1.68	0.80	0.89	0.84	0.76	0.91	0.83	27.81	28.13	27.97	0.75	0.68	0.71
	50	3.30	3.64	3.47	1.16	1.35	1.25	2.14	2.29	2.21	27.50	27.81	27.66	1.30	1.32	1.31
	100	3.82	4.46	4.14	1.26	1.41	1.33	2.56	3.05	2.8	27.50	27.19	27.35	1.49	1.36	1.42
	200	4.09	4.14	4.11	1.44	1.31	1.37	2.65	2.83	2.74	27.19	26.88	27.04	1.47	1.40	1.43
	Mean	3.19	3.51	3.35	1.17	1.24	1.2	2.03	2.27	2.15	27.50	27.50	27.50	1.25	1.19	1.22
3rd	0	1.73	2.17	1.95	0.74	0.84	0.79	0.99	1.33	1.16	28.13	27.50	27.82	0.64	0.81	0.72
	50	2.55	2.53	2.54	1.32	1.36	1.34	1.23	1.17	1.2	28.13	27.19	27.66	1.29	1.29	1.29
	100	3.59	4.21	3.9	1.47	1.61	1.54	2.12	2.60	2.36	27.81	26.88	27.35	1.38	1.49	1.43
	200	4.06	3.32	3.69	1.09	1.41	1.25	2.97	1.91	2.44	27.81	26.56	27.19	1.42	1.45	1.43
	Mean	2.98	3.06	3.02	1.16	1.31	1.23	1.83	1.75	1.79	27.97	27.03	27.50	1.18	1.26	1.22
Average	0	1.69	1.83	1.76	0.77	0.85	0.81	0.91	0.98	0.94	28.02	27.81	27.92	0.63	0.68	0.65
	50	2.92	2.84	2.88	1.30	1.33	1.31	1.62	1.50	1.56	27.81	27.40	27.61	1.23	1.26	1.24
	100	3.88	4.03	3.95	1.51	1.55	1.53	2.37	2.49	2.43	27.60	26.98	27.30	1.45	1.45	1.45
	200	4.04	3.61	3.82	1.27	1.41	1.34	2.77	2.20	2.48	27.40	26.77	27.09	1.45	1.45	1.45
	Mean	3.13	3.08	3.1	1.22	1.29	1.25	1.92	1.79	1.85	27.71	27.24	27.48	1.19	1.21	1.2

Concerning the effect of application date, the average across growth regulator type and rate, illustrated that the highest reducing sugars was obtained by spraying the plants with growth regulator during seedling stage, while the highest non-reducing and total soluble sugars were obtained by preflowering application of growth regulators.

Regarding the effect of growth regulator concentration (regardless its type and application date) it was noticed that increasing growth regulator concentration in the spraying solution, encourage the synthesis of mono-saccharides and its conjunction to produce non-reducing sugars. However, 200 ppm growth regulator application rate was slightly less effective than 100 ppm rate.

In the interaction between growth regulator type and application date, it could be observed that IAA was more effective than GA_3 when they applied during seedling stage, where the concentration of reducing, non-reducing and total soluble sugars reached 1.32, 1.9 and 3.22% respectively for IAA application, while the corresponding values in the case of GA_3 application were 1.30, 1.35 and 2.66% respectively. However, at the preflowering application date, GA_3 application encourage the production of sugars more than that induced by IAA application.

Concerning the interaction between growth regulator type and application rate, it was noticed that the highest reducing, non-reducing and total soluble sugars concentrations were obtained by the application of 100 ppm IAA or GA_3 (with slight differences between

their effect), while increasing the application rate up to 200 ppm reduced growth regulator efficiency.

Finally, the interaction between growth regulator type x application date x application rate illustrated that the highest reducing sugars concentration was obtained by the application of 100 ppm IAA during seedling stage, while the highest non-reducing and total soluble sugars concentrations were obtained by spraying the plant with 100 ppm GA_3 at preflowering stage. This could be attributed to the effect of 100 ppm GA_3 or IAA application on increasing cell division and elongation, which in turn increased leaf area and consequently enhanced photosynthetic rate and translocation of photosynthate from leaves to developing seeds inducing an increase in soluble sugars concentration in the seeds. In this respect Younis et al. (1971) and Gale et al. (1974) pointed out that GA_3 treatments increased photosynthetic rate and translocation of photosynthates from leaves to seeds and increased the activity of enzymes involved in sugar synthesis. Moreover, Mohamed (1993) reported that GA_3 treatment induced an increase in the activity of three enzymes (aldolase 6.p reductase, sucrose synthetase and sorbitol dehydrogenase) in the plants which stimulate the synthesis of soluble sugars.

4.2.8.2. Total phenols concentration :

The data presented in Table (25) illustrated that in spite of the increase in phenols concentration induced by the application of growth regulator, but there was no obvious differences neither

between the two growth regulators type nor between the three application dates.

Moreover, it was noticed from the data presented in this table that increasing growth regulator application rate up to 100 ppm increased phenols concentration in the seed, however, an increase in growth regulator concentration up to 200 ppm did not induce any further increase in phenols concentration.

Generally, the highest phenols concentration (1.4%) was obtained by the application of 100 ppm IAA or GA_3 during seedling stage or at preflowering stage.

4.2.8.3. Protein yield :

Protein contents in the soybean seeds considered the major component that determines the seed quality. The concerning the effect of various growth regulators treatment on seed protein yield. The results revealed that GA_3 was more effective than IAA in this respect.

However, the application of growth regulator at preflowering stage was more effective than other two application dates, where the values of seed protein yield reached 927, 982 and 906 mg/plant for growth regulator application during seedling stage, preflowering stage and presetting stage respectively (as an average across growth regulator type and rate) as indicated in Table (25).

Moreover, it was noticed that increasing growth regulator application rate up to 100 ppm enhanced protein synthesis, but further increase up to 200 ppm induced a reverse effect where seeds protein

decreased to be 888 mg/plant while in the control plant it was 916 mg/plant.

Regardless growth regulator application rate, it was observed that at the first and the second application dates GA_3 was more effective than IAA, while at the late application date, the effectiveness of IAA was slightly higher than that of GA_3 in increasing the seed protein yield. In this respect Bidwell (1979) pointed out that IAA stimulate RNA synthesis and in turn protein synthesis.

Generally, the obtained data revealed that the highest protein yield was obtained by preflowering application of 100 ppm IAA or GA_3 with superiority to GA_3 where seed protein yield reached 1028 and 1063 mg/plant for IAA and GA_3 respectively. This was in accordance with the finding of Harb (1992a) and Shahine et al. (1992b).

The effectiveness of preflowering application of 100 ppm GA_3 in increasing the yield of protein in seeds could be attributed to its effect on increasing photosynthesis rate as indicated by the increase in soluble sugars in leaves at the second sample (Table 21). This in turn increase the rate of soluble sugars translocation from the leaves to the seed during seed filling. As soluble sugars is the main carbon skeleton for amino acid synthesis and consequently protein production, the increase in soluble sugars in the seed encourage its transformation to protein (when nitrogen was not the limiting factor). The increase in photosynthetic activity induced by GA_3 application was pointed out by Marcelle and Oben (1973) and Sankhla and Huber (1974) and

(1975). It was also reported by Patrich and Wareing (1982) that the application of some growth regulates stimulated protein and RNA synthesis in *Phaseolus vulgaris*.

4.2.8.4. Oil yield :

The seed oil yield as affected by various growth regulator treatments was presented in Table (25). The foliar application of GA_3 was more effective in increasing oil yield than IAA application, where seed oil yield reached 619 and 665 mg/plant for IAA and GA_3 application respectively (as an average across growth regulator application date and rate).

Regarding the effect of application date, it was noticed that the preflowering application of growth regulator could be considered the most beneficial application date for increasing oil yield.

Concerning the effect of growth regulator application rate (irrespective of growth regulator type and application date), the obtained data revealed that increasing application rate up to 100 ppm increased oil yield, while further increase up to 200 ppm induced a reverse effect. This was true for each growth regulator (IAA or GA_3).

Generally, the interaction between growth regulator type x application date x application rate revealed that the highest oil yield was obtained by preflowering application of 100 ppm GA_3, while increasing the application rate up to 200 ppm reduced the seed oil yield to be lower than the control. This was in accordance with the finding of Nabila and Nagwan (1996) as they found that oil content in

safflower seeds decreased progressively by increasing GA_3 application rate.

The increase in seed oil yield in plants sprayed with lower rate of GA_3 was reported also by El-Antably et al. (1975).

Finally, it could be concluded from the foregoing discussion that preflowering application of 100 ppm GA_3 could be considered the best treatment, which produced the highest seed yield (by increasing both seed number/plant and seed filling) and the best seed quality (oil content, protein content and soluble sugars percentage). On the other hand, preflowering application of 100 ppm IAA was also effective in this respect but its efficiency was slightly lower than GA_3.

Table (26) L.S.D. (0.05) Values for clover growth parameters.

	Plant height	Fresh weight	Dry weight
G.R. type (T)	2.188	4.480	0.100
Date of appl. (D)	2.679	5.487	0.120
T × D	3.789	N.S.	0.170
Rate of appl. (R)	3.094	6.336	0.144
T × R	4.375	8.961	0.204
D × R	5.359	10.970	0.249
T × D × R	N.S.	N.S.	0.353

Table (27) L.S.D. (0.05) Values for soybean yield attributes.

	Fresh weight	Dry weight	Number of pods	Number of seeds	Seed index
G.R. type (T)	0.089	0.091	0.306	0.047	0.193
Date of appl. (D)	0.109	0.111	0.375	N.S.	0.236
T × D	0.154	0.157	0.531	0.082	0.334
Rate of appl. (R)	0.126	0.128	0.433	0.067	0.273
T × R	0.178	0.181	0.613	0.095	N.S.
D × R	0.218	0.222	0.751	0.177	0.473
T × D × R	0.309	0.313	N.S.	0.165	N.S.

Table (28) L.S.D. (0.05) Values for soybean seed yield

	Seed yield	Oil yield	Protein yield
G.R. type (T)	0.204	38.30	N. S.
Date of appl. (D)	0.249	N. S.	N. S.
T × D	N. S.	N. S.	N. S.
Rate of appl. (R)	N. S.	54.16	N. S.
T × R	0.407	N. S.	111.9
D × R	0.499	N. S.	137.0
T × D × R	0.705	N. S.	171.1

SUMMARY

The main objectives of this investigation are to study the effect of some growth regulators, i.e. indole^{-3}. Acetic acid and gibberellic acid on some leguminous plants, i.e. berseem clover (*Trifolium alexandrinum L.)* and soybean *(Glycine max L.)* as forage and seed crop respectively. Two successive pot experiments were carried out in the greenhouse of Plant Nutrition Department, Soil, Water and Environment Research Institute, Agricultural Research Center, during 1996 and 1997 seasons.

Four growth regulator concentrations, i.e. 0, 50, 100 and 200 ppm were sprayed at one of different three times : 21 days before the first cut, 21 days before the second cut or 21 days before the third cut (for clover) and at seedling stage, at preflowering stage or at presenting stage (for soybean).

The effect of these treatments on the two leguminous plants was determined in the following measurements.

*) **Plants height.**

*) **Fresh weight.**

*) **Dry weight.**

*) **Plant nutrients concentration (N, P, K, Ca and Mg).**

*) **Pigments concentration : chlorophyll a, chlorophyll b and carotens.**

*) **Reducing, non-reducing and total soluble sugars concentration.**

*) **Total phenols concentration.**

*) **Some yield components of soybean plant : number of pods per plant, number of seeds per pod, seed yield per plant and weight of 100 seeds.**

The results can be summarized as follows :

A. The effect on clover plant :

1) In spite of the promotove effect of the two types of growth regulators used in this study (IAA and GA_3) there was a great differences between their effects on plant height where GA_3 was more effective than IAA in this respect.
2) However, there was no significant differences between the two growth regulators (IAA and GA_3 regarding their effect on plant weight).
3) It could be concluded that the highest total fresh weight (the summation of three cuts) was obtained by the application of 100 ppm GA_3\or IAA, 21 days before the first out.
4) There was no differences between the two growth regulator types where the total plant dry weight during the whole growth season reached 29.41 and 29.13 g/pot for IAA and GA_3 application respectively (as an average across application data and rate).
5) Both IAA and GA_3 application slightly decreased N, P, K, Ca and Mg concentrations. It is noticed that 100 ppm application resulted the lowest values of nutrients concentration while 200 ppm application did not cause more decreasing. There was no noticeable effect due to type of the growth regulator or to date of application in this respect.

6) Both IAA and GA_3 application decreased the concentration of all pigments. There were slight differences between the effect of the growth regulator types and no obvious differences between the three application times in this respect. However, increasing growth regulator application rate reduced the concentration of all pigments.

7) Total soluble, reducing and non-reducing sugars were increased with growth regulator increasing up to 100 ppm, while further increase in growth regulator concentration reduced its effect.

8) There was no obvious differences between the effect of IAA and GA_3 on protein percentage. In addition, there was no detectable effect due to time of growth regulator spraying. However, protein percentage was decreased with growth regulator concentration up to 200 ppm.

9) Total phenols were increased with both IAA and GA_3 application. There was no obvious differences between the three application dates, while increasing the application rate of growth regulator increased its enhanceing effect on phenols synthesis.

B. <u>The effect on soybean plant</u> :

10) At various growth stage, GA_3 was more effective than IAA on increasing plant height. The preflowering application of IAA or GA_3 was more effective than their application at seedling stage.

11) During seedling stage, plants responded to both IAA and GA_3 in the same manner, while during the preflowering stage, the effect of IAA on increasing plant fresh and dry weights was slightly higher than the effect of GA_3. Increasing the concentration of growth regulator to 100 ppm induced appreciable increase in plant fresh and dry weights but further increase in growth regulator concentration up to 200 ppm reduced its effectiveness.

12) Plant nutrients concentration was decreased with increasing growth regulator concentration up to 200 ppm growth regulator types had no respectable differences in this respect.

13) The application of either IAA or GA_3 to soybean plants decreased the concentration of all pigments in leaf (chl. A, chl. B, total chl. and carotens). There were slight differences between the effect of the two growth regulator types in this respect. Also, there were no obvious differences between the two spraying times in this manner.

14) At seedling stage the application of GA_3 was more effective than IAA in increasing soluble sugars in soybean plant, while at preflowering stage, the enhancing effect of IAA on soluble sugars was similar to that obtained by GA_3 application.

15) Increasing application rate of growth regulator up to 100 ppm, increased the concentration of soluble sugars, while further increase in growth regulator concentration reduced its effect, with the exception of the concentration of non-

reducing sugars during seedling stage which increased by increasing growth regulator application up to 200 ppm.

16) Protein concentration was decreased with growth regulator application. There was no obvious difference between the two application dates in this respect. Increasing the application rate of growth regulator up to 200 ppm decreased protein percentage.

17) Both IAA and GA_3 application increased the concentration of phenols compared to the untreated plants. There was no obvious differences between the application dates in this respect. However, increasing the application rate of growth regulator increased its enhancing effect on phenols synthesis.

18) Both IAA and GA_3 were effective in increasing pods fresh and dry weights, seed yield, number of pods/plant, number of seeds/pod as well as seed index (weight of 100 seeds), however GA_3 was more efficient than IAA in this respect. The data revealed that growth regulator application at preflowering stage produced the highest yield compared with the other two application dates. However, the number of seeds/pod and seed index was not affected by the application.

19) The fresh and dry weights of pods as well as seed yield, number of pods/plant, number of seeds/pot and seed index were increased by increasing growth regulator application rate up to 100 ppm but further increase to 200 ppm reduced its enhancing effect.

20) Soluble sugars in seeds was increased by growth regulator application. GA_3 was more effective in increasing reducing sugars while IAA have much effective to condensate mono-saccharides to non-reducing sugars. Increasing growth regulator concentration encourage the synthesis of mono-saccharides and its conjunction to produce non-reducing sugars. However, 200 ppm growth regulator application rate was slightly less effective than 100 ppm rate.

21) Total phenols concentration in seeds was increased by increasing growth regulator application rate up to 100 ppm but an increase in growth regulator concentration up to 200 ppm did not induce any further increase in phenols concentration.

22) Seed protein yield was increased by the application of growth regulator. The application of growth regulator at preflowering stage was more effective than the other two application dates. Increasing growth regulator application rate up to 100 ppm enhanced protein synthesis, but further increase up to 200 ppm induced a reverse effect.

23) Oil yield was affected by growth regulator application GA_3 was more effective in increasing oil yield than IAA application. In this respect, the preflowering application of growth regulator could be considered the most beneficial application date for increasing oil yield.

24) It could be concluded that preflowering application of 100 ppm GA_3 could be considered the best treatment, which produced the highest seed yield (by increasing both seed number/plant and seed filling) and the best seed quality (oil content, protein content and soluble sugars percentage). On the other hand, preflowering application of 100 ppm IAA was also effective in this respect but its efficiency was slightly lower than GA_3.