RESULTS AND DISCUSSION

FIRST PART : Pot Experiment.

Effect of Irradiation on Germination (%) and Seedling characters :

1. Germination percentage :

Data presented in Table (2) indicate that the effect of irradiation on germination (%) was not clear trend in the two successive seasons. Seasonal variation was also observed.

In 1982/83 season, irradiation of seeds with 0, 1, 2, 4 and 8 K. rad doses of gamma rays had no significant effect on germination (%). On the other hand, the same treatments showed significant effect on percentage of germination in the second season. Results reveal that the doses of 1, 4 and 8 K. rad tended to greater increase in this character, on the other side, the dose of 2 K. rad was the treatment which tended to a greater reduction in germination percentage. The oppossite trend has been achieved in the first season whereas, the 2 K. rad dose was the treatment which increased this character more than other doses as well as the control.

The stimulating effects of radiation on germination of seeds might be due to a shortening or breaking of seed dormancy as reported by Bilquez and Martin (1961).

Table (2): Effect of gamma-ray doses on germination percentage and seedling characters.

Gamma-rays doses in (K. rad)	Germination (%)	Germination rate index	Root length (cm.)	Seedling height (cm.)	Number of leaves seedling	Dry weight of seedling (mg.)
		a). 1982/1983 season				
0	73.33	0.56	5.63	6.13	5.06	31.66
1	61.33	0.73	5.03	7.76	5.03	42.00
2	74.66	0.86	4.83	6.56	4.60	39.00
4	40.00	0.66	3.66	7.76	5.13	35.33
8	57.33	0.74	4.50	9.23	4.60	38.00
L.S.D.at 5%	N.S.	N.S.	0.50	1.26	0.25	3.77
		b). 1983/1984 season				
0	70.66	0.69	6.10	6.53	4.83	39.66
1	78.66	0.73	4.76	7.13	4.90	40.66
2	50.66	0.72	4.10	6.83	5.06	38.00
4	73.33	0.84	4.10	6.86	4.86	36.00
8	78.66	0.88	4.16	8.30	5.03	27.66
L.S.D.at 5%	11.43	N.S.	N.S.	N. S.	N.S.	4.07

On the other hand, the inhibiting effects of higher radiation doses on germination noticed might be due to an increasing inhibiting effect on substances responsible for seed germination and an increase in the production of active radicals that are responsible for seed lethality as reported by Brock (1965).

The effect of gamma ray doses on germination (%) was studied by many investigators, Hassanine (1973) and Moursy (1972) reported that lower gamma rays doses increased the germination (%) of field bean. Whereas, increasing irradiation dose from 0 to 100 K. rad decreased gradually in germination, (Siyanova, 1963; El-Sayed, 1966 and Matsumura, 1966). On the other hand, Atia (1986), reported that exposing seeds of field bean to various gamma doses up to 5 K. rad did not show significant effect on germination (%) in laboratory experiment. While germination (%) tended to decrease obviously by increasing doses of gamma ray in field experiment.

2. Germination rate index :

Data in Table (2) show that irradiation had no significant effect on germination rate index in the two successive seasons. Whereas the doses of gamma rays increased germination rate index more than the control in the both seasons. This result was not agree with those obtained by Thabet (1985).

3. Root length :

Data presented in Table (2) indicate that irradiation of seeds with gamma rays doses showed a slight effect on length of root. Seasonal variation in this respect was observed. In 1982/83,the irradiation of seeds with gamma rays doses of 1, 2, 4 and 8 K. rad induced significantly reduction in root length of seedling after 30 days from sowing less than the unirradiated seeds.

These results did not agree with those obtained by Atia (1986), who found that various doses caused significant increase in main root length of field bean compared with the untreated seeds (control) and the tallest root was observed at 4 K. rad during the two seasons.

4. Seedling height:

Data on seedling height as influenced by gamma rays doses are shown in Table (2).

In 1982/83 season, the height of seedling stem increased significantly as the gamma doses increased up to 8 K. rad. On the other hand, the effect of gamma rays on seedling height after 30 days from sowing was not significantly in the second season. It could be concluded that the doses of 1, 4 and 8 K.rad were the doses whose have greater

effect in increasing this character than other doses as well as the control treatment in the first season only.

Similar conclusion was observed by Atia (1986). He reported that all gamma irradiation doses increased significantly seedling height of field bean as compared to control.

5. Number of leaves/seedling :

Data presented in Table (2) indicate clearly that the effect of gamma rays on the number of leaves/seedling showed seasonal variation.

In the first season, number of leaves/seedling significantly decreased by increasing gamma irradiation doses in the first season. Whereas, the effect of gamma rays failed to reach the significant level at 5% in the second season.

6. Dry weight/seedling :

Results in Table (2) show that the effect of gamma rays on dry weight/seedling had no particular trend could be detected in the two successive seasons. In 1982/83, dry matter weight/seedling significantly increased as the gamma doses increased compared with control treatment. Whereas, the dose of 1 K. rad produced the greatest dry weight/seedling.

In 1983/84, the oppossite trend has been observed while, significantly reduction has been noticed at 4 and 8 K. rad compared with the dose of 1 K. rad.

The effect of gamma rays on the dry weight of seedling was studied by many investigators. Atia, (1986), reported that irradiation with gamma rays up to 5 K. rad achieved significant increases in fresh and dry weight of 100 seedlings and their roots as compared to the control. On the contrary, Sharabash et al. (1973) and Thabet (1985), showed that dry weight of 100-seedlings determined 30-days after sowing, decreased significantly and continuously by increasing gamma-irradiation doses. It might be due to high rate of hydrolysis of sucrose to mono saccharides and partial hydrolysis of polysaccharides causing high respiration in comparison to photosynthesis which reflected on decreasing the dry weight of seedlings.

The increases or decreases in seedling characters, namely, root length, seedling height, number of leaves per seedling, may be due to the changing in physiological aspects in inhancing or inhibition of the enzymatical processes on seed conistituents which induced by irradiation and then reflexed on the energy which produced available compounds for the embryo during germination.

SECOND PART : Field Experiment.

A. Effect of Gamma Irradiation and IAA :

I. Growth and Yield:

1. Plant height :

Data presented in Tables (3 and 4) show that height of fenugreek plants was significantly influenced by irradiation and IAA.

Plant height significantly increased as the gamma doses increased up to 1 K. rad at 45 days from sowing in the both seasons and at 75 days from sowing in the second season, only (Tables 3 and 4). Increasing the doses of gamma-rays up to 8 K. rad significantly decreased the plant height. The tollest plants were observed by exposing seeds to 1 K.rad in the two successive seasons.

It could be concluded that lower radiation doses (1 K. rad) had significant stimulating effect on plant height, whereas, higher radiation doses (2, 4 and 8 K. rad) inhibited fenugreek growth expressed as plant height. The stimulating effect of lower doses may be due to stimulating enzymes responsible for metabolic activity in plants leading to an increase in plant growth. On the other hand, higher radiation doses are known to increase the production of anabolic enzymes leading to an increase in respiration

Table (3): Effect of gamma irradiation and IAA concentrations on plant height (cm) in 1982/83 season.

IAA Concentrations (ppm)	Gamma ray doses in K. rad					Average of I A A
	0	1	2	4	8	
	a). 45 days from sowing					
0	22.6	27.6	25.1	22.3	20.4	23.5
20	25.2	28.2	26.3	23.1	20.1	24.6
40	23.8	28.9	20.0	21.0	18.1	22.3
Average of Gamma doses	23.8	28.1	23.8	22.1	19.5	
L.S.D. 5% for:	IAA = 1.24, Gamma dose = 2.60, Interaction = 2.78					
	b). 75 days from sowing					
0	42.7	46.4	45.7	42.6	37.8	43.0
20	45.1	47.4	47.0	41.8	36.7	43.6
40	48.1	46.3	41.6	39.6	40.9	43.3
Average of Gamma doses	45.3	46.7	44.7	41.3	38.4	
L.S.D. 5% for:	IAA = N.S., Gamma dose = 3.12, Interaction = N.S.					
	c). 160 days from sowing (at harvest stage):					
0	55.0	60.7	52.0	50.7	47.7	51.9
20	50.0	49.1	47.7	46.0	44.0	47.3
40	44.5	43.7	42.6	41.7	41.3	42.8
Average of Gamma dose	49.8	48.9	47.4	46.1	44.3	
L.S.D. 5% for:	IAA = 3.35, Gamma dose = 3.79, Interaction = N.S.					

Table (4): Effect of gamma irradiation and IAA concentrations on plant height in 1983/84 season.

I A A concentrations (ppm)	Gamma ray doses in K. rad					Average of I A A
	0	1	2	4	8	
	a). 45 days from sowing					
0	48.9	52.4	51.2	43.1	39.5	47.0
20	49.8	53.4	53.2	42.0	37.6	47.2
40	47.7	53.8	52.6	41.1	37.3	46.5
Average of Gamma doses	48.8	53.2	52.3	42.1	38.1	
L.S.D. 5% for: IAA = N.S., Gamma dose = 4.105, Interaction = N.S.						
	b). 75 days from sowing					
0	68.5	69.3	69.8	67.6	67.3	68.5
20	68.4	67.8	68.5	66.4	66.1	67.4
40	67.6	66.1	66.9	65.7	64.4	66.2
Average of Gamma doses	68.2	67.7	68.4	66.6	65.9	
L.S.D. 5% for: IAA = N.S., Gamma dose = N.S., Interaction = N.S.						
	c). 160 days from sowing (at harvesting stage)					
0	73.3	73.8	72.9	72.1	69.7	72.4
20	72.6	72.7	71.8	71.4	65.6	70.8
40	71.4	71.0	70.4	67.0	63.4	68.6
Average of Gamma doses	72.4	72.5	71.7	70.2	66.2	
L.S.D. 5% for: IAA = N.S., Gamma dose = N.S., Interaction = N.S.						

rate and reduced growth. Similar results were reported by Sharabash et al. (1973) on wheat, El-Sayed and Wally (1977) on tomato, El-Hosary (1977), Saleh (1978), Atia (1981) on field bean, Moursi et al. (1980) on snap bean plant , and Atia (1986) on field bean.

Effect of IAA on plant height of fenugreek showed seasonal variations (Tables 3 & 4).

In 1982/83 season, spraying of IAA had significant effect on plant height at 45 days from sowing,only. Results reveal that the first rate of IAA (20 ppm) was more effective in this respect than the second rate (40 ppm). This result indicates that IAA effect was more pronounced during the early vegetative stages of growth.

In 1983/84, IAA application did not show significant effect on plant height of fenogreek, where the differences in the plant height failed to reach the significant level (Tables 3 & 4).

It could be concluded that IAA showed a significant effect on plant height at 45 days from sowing in the first season. These results are expected since IAA is known to cause marked increases in cell elongation (Holm, 1977), increase the number of internodes, plant and length of

4th internode (Castro and Moraes, 1980). These results are in agreement to those observed by Moursy (1972), Saleh (1978), Atia (1981), Abd Allah and Abd El-Rahim (1982) and Atia (1986).

The effect of interaction between gamma-rays and IAA on this character was not significant. Such result indicates that each experimental factor acted separately in affecting the growth of fenugreek plants.

2. Dry weight per plant :

Data presented in Tables(5 and 6) show that the effect of gamma rays on the dry weight/plant was significant at different stages of growth in the two successive seasons. The greatest dry weight/plant was produced by exposing seeds at 2 K. rad in the first and second seasons. Moreover, the dry weight/plant tended to be decreased by exposing seeds to irradiation up to 8 K. rad in the both seasons.

Such results are expected since lower radiation doses stimulated plant growth leading to an increase in plant height and number of branches/plant and higher doses reduced these characters showing an inhibiting effect.

Table (5): Effect of gamma irradiation and IAA concentrations on dry weight/plant (g.) in 1982/83 growing season.

I A A concentrations (ppm)	Gamma ray doses in K. rad					Average of I A A
	0	1	2	4	8	
a). 45 days from sowing						
0	2.73	2.76	2.80	2.53	2.36	2.64
20	2.53	1.96	3.60	2.13	1.60	2.36
40	2.63	3.60	3.00	3.90	2.66	3.10
Average of Gamma doses	2.63	2.68	3.13	2.85	2.21	

L.S.D. 5% for : IAA = 0.39, Gamma dose = 0.504 and Interaction = 0.873

b). 75 days from sowing						
0	3.76	3.90	4.23	3.83	3.83	3.91
20	3.93	4.03	4.13	3.56	3.60	3.85
40	4.13	4.13	4.50	3.40	2.80	3.79
Average of Gamma doses	3.94	4.02	4.28	3.60	3.41	

L.S.D. 5% for : IAA = 0.277, Gamma doses = N.S. and Interaction = 0.480

Table (6): Effect of gamma irradiation and IAA concentrations on dry weight/plant in 1983/84 growing season.

I A A concentrations (ppm)	Gamma-ray in K. rad					Average of I A A
	0	1	2	4	8	
a). 45 days from sowing						
0	2.86	2.76	2.73	2.43	2.30	2.62
20	2.86	2.86	2.93	2.46	2.06	2.64
40	2.93	3.00	3.10	2.16	2.30	2.70
Average of Gamma doses	2.88	2.87	2.92	2.35	2.22	

L.S.D. 5% for: IAA= N.S.,Gamma dose= 0.299 and Interaction= N.S.

b). 75 days from sowing						
0	4.53	4.76	4.56	4.36	4.06	4.46
20	4.40	4.90	4.70	4.23	4.00	4.44
40	4.33	4.80	4.56	4.13	3.76	4.32
Average of Gamma doses	4.42	4.82	4.61	4.24	3.94	

L.S.D. 5% for: IAA=N.S., Gamma doses=0.175 and Interaction=N.S.

Similar results were recorded by several investigators, on some plants (Abo El-Saod and Omeran, 1975) and on field bean (Battah, 1981 and Atia, 1986).

Effect of IAA on dry weight/plant of fenugreek showed seasonal variations (Tables 5 & 6).

In 1982/83 season, IAA had significant effect on these characters with no particular trend was observed. At 45-day from sowing, dry weight/plant significantly increased as IAA increased up to 40 ppm. On the other hand, IAA showed an inhibiting effect on dry weight/plant at 75 days from sowing (Table 5).

In 1983/84, spraying of IAA did not show significant effect on dry weight/plant at 1st and 2nd samples (Table 6).

It could be concluded that the effect of IAA on dry weight/plant showed no particular trend could be detected at different stages of growth in the two seasons.

The effect of IAA on dry weight/plant was studied by many investigators. Castro et al. (1975) on sugar-cane, Saleh (1978), Battah (1981) and Atia (1986) on field bean, reported that dry weight/plant tended to significantly increase by spraying plants with IAA as compared with the untreated plants.

The effect of the interaction between gamma-rays and IAA on the dry weight/plant was significant in the first season at 45 and 75-day in 1982/83 and not significant in 1983/84 season.

In 1982/83 season, heavier dry weight/plant was produced by exposing seeds at 4 K. rad and spraying with 40 ppm at 45 days from sowing and at 2 K. rad and spraying with 40 ppm at 75 days from sowing. These results are in harmony with those obtained by Atia (1986).

3. Number of branches/plant :

The results in Tables (7 and 8) indicate clearly that gamma rays doses showed no significant effects on the number of branches/plant in the two seasons at 45 , and 75 days from sowing. At harvesting stage gamma rays had significant effect on the number of branches/plant (Tables 7 and 8). In general, the number of branches/plant significantly decreased as the gamma rays doses increased up to 8 K. rad at different stages of growth (at harvest time). These results did not agree with those obtained by Saleh (1978); Moursi et al. (1980); Tolba (1980); Atia (1981); Battah (1981) and Atia (1986). They reported that averages of number of branches/plant of legumes crops tended to be greater by exposing seeds to gamma irradiation.

Table (7): Effect of gamma irradiation and IAA on the number of branches/plant in 1982/83 season.

I A A concentrations (ppm)	Gamma ray doses in K. rad					Average of I A A
	0	1	2	4	8	
	a). 45 days from sowing					
0	1.73	2.60	1.60	2.40	2.53	2.17
20	3.66	2.80	1.07	2.26	2.26	2.42
40	1.80	1.80	2.26	2.40	4.07	2.46
Average of Gamma doses	2.40	2.41	1.64	2.35	2.95	

L.S.D. at 5% for: IAA = N.S., Gamma = N.S. and Interaction = N.S.

	b). 75 days from sowing					
0	1.53	1.26	2.10	1.73	1.73	1.68
20	1.60	1.90	1.53	4.33	2.13	2.30
40	3.20	3.13	2.33	2.60	2.60	2.77
Average of Gamma doses	2.11	2.10	2.00	2.89	2.15	

L.S.D. at 5% for: IAA = N.S., Gamma = N.S. and Interaction = N.S.

	c). 160 days from sowing (at harvesting stage)					
0	3.10	2.93	2.80	2.43	2.23	2.70
20	2.90	3.36	3.06	2.00	2.00	2.66
40	2.86	3.16	2.93	1.83	1.80	2.52
Average of Gamma doses	2.95	3.15	2.93	2.08	2.01	

L.S.D. at 5% for: IAA = N.S., Gamma = 0.451 and Interaction = N.S.

Table (8): Effect of gamma irradiation and IAA on the number of branches/plant in 1983/84 season.

I A A concentrations (ppm)	Gamma ray doses in K. rad					Average of I A A
	0	1	2	4	8	
	a). 45 days from sowing					
0	2.83	2.76	2.13	2.30	1.53	2.31
20	1.83	1.76	1.90	2.06	1.33	1.78
40	1.73	1.60	1.63	1.63	1.26	1.57
Average of Gamma doses	2.13	2.04	1.88	2.00	1.37	

L.S.D. AT 5% for: IAA = N.S., Gamma = N.S. and Interaction = N.S.

	b). 75 days from sowing					
0	5.30	5.43	5.40	4.50	4.36	5.00
20	4.86	4.93	4.93	4.26	3.66	4.53
40	4.26	4.10	3.90	3.20	3.53	3.80
Average of Gamma doses	4.81	4.82	4.74	3.98	3.85	

L.S.D. at 5% for: IAA = N.S., Gamma = N.S. and Interaction = N.S.

	c). 160 days from sowing (at harvesting stage)					
0	3.26	3.13	3.00	2.60	2.46	2.89
20	3.16	3.03	2.83	2.76	2.66	2.89
40	3.00	2.86	2.60	2.56	2.56	2.72
Average of Gamma doses	3.14	3.01	2.81	2.64	2.56	

L.S.D. at 5% for: IAA = N.S., Gamma = 0.342 and Interaction = N.S.

Results in Tables (7 and 8) show that application of IAA had no significant effect on the number of branches/plant in the two successive seasons. This result indicates that there was no relevance between the IAA and the number of branches/plant. On the contrary, Saleh (1978); Atia (1981); Battah (1981) and Atia (1986) showed average number of branches/plant appeared significantly greater by spraying plants with 75 and 150 ppm IAA as compared with the control.

The effects of the interaction between gamma rays doses and IAA on this character was not statistically significant. Consequently, interaction data were excluded.

4. Number of pods per plant :

Data presented in Tables (9 and 10) indicate that in 1982/83 season the gamma ray dose did not affect the number of pods/plant at different growth stages, namely 45, and 75 days from sowing.

In 1983/84, the doses of 4 and 8 K. rad significantly decreased number of pods/plant at various stages of growth. Besides that, the doses of 1 and 2 K. rad increased number of pods/plant at the 2nd sample after 75 days from sowing (Table, 9).

Table (9): Effect of gamma irradiation and IAA on the number of pods/plant in 1982/83 season.

I A A concentrations (ppm)	Gamma ray doses in K. rad					Average of I A A
	0	1	2	4	8	
	a). 45 days from sowing					
0	0.33	0.93	0.66	1.00	0.80	0.75
20	0.73	0.53	0.60	0.60	0.43	0.58
40	0.90	0.80	1.00	0.53	0.86	0.82
Average of Gamma doses	0.65	0.76	0.76	0.71	0.70	

L.S.D. at 5% for: IAA = N.S., Gamma = N.S. and Interaction = N.S.

	b). 75 days from sowing					
0	3.13	1.93	3.87	3.20	3.33	3.09
20	4.23	3.33	1.67	8.07	4.27	4.31
40	4.00	4.73	5.60	3.80	5.40	4.75
Average of Gamma doses	3.78	3.33	3.77	5.02	4.33	

L.S.D. at 5% for: IAA = N.S., Gamma = N.S. and Interaction = N.S.

Table (10): Effect of gamma irradiation and IAA on the number of pods/plant in 1983/84 season.

I A A concentratios (ppm)	Gamma ray doses (K. rad)					Average of IAA
	0	1	2	4	8	
a). 45 days from sowing						
0	1.03	1.10	1.20	0.66	0.70	0.94
20	1.00	0.86	0.83	0.76	0.53	0.80
40	0.56	0.66	0.60	0.63	0.36	0.56
Average of γ-ray	0.86	0.87	0.87	0.68	0.53	

L. S. D. at 5% for: IAA = ~~N.S.~~ 0.183, gamma doses = ~~N.S.~~ 0.236, Interaction = N.S.

b). 75 days from sowing						
0	6.16	7.03	6.53	6.23	4.56	6.10
20	6.16	6.66	6.83	5.70	4.50	5.97
40	5.40	5.83	6.00	4.66	4.76	5.33
Average of γ-ray	5.91	6.51	6.45	5.53	4.61	

L. S. D. at 5% for: IAA = N.S., gamma = ~~N.S.~~ 0.915, Interaction = N.S.

These results not agree with those obtained by Saleh (1978); Moursi et al. (1980); Tolba (1980); Atia (1981); Battah (1981) and Atia (1986). They reported that number of pods/plant of field bean tended to increase by gamma irradiation as compared with the control treatment.

The results in Tables (9 and 10) show clearly that IAA application had no significant effect on the number of pods/plant in the first season. While, in the other season, the number of pods/plant insignificantly decreased as the IAA increased up to 40 ppm in the 1st and 2nd samples (Tables (9 and 10).

The effect of IAA on the number of pods/plant was studied by many investigators. Atia (1986) found that no significant differences were observed between average number of pods/plant as affected by IAA. On the other hand, El-Waziry and Abo-El-Lil (1978); Saleh (1978) and Atia (1981), they reproted that the number of pods/plant significantly increased by IAA spray. The differences between various investigators might be due to differences in sowing date, spraying date, edaphic or weather conditions or any other factor which needs further investigation.

The effect of interaction between gamma doses and IAA on the number of pods/plant was not significant in the two

successive seasons. Concequently, the data were excluded (Tables 9 and 10). Such result indicates that each experimental factor acted separately in affecting the number of pods/plant.

5. Weight of 100-seed :

Gamma ray doses showed no significant effect on the 100-seed weight in the two successive seasons (Table 11).

In 1982/83 season, the weight of 100 seeds insignificant decreased with increasing gamma doses up to 8 K.rad compared with the control treatment (Table 11).

In 1983/84 season, the effect of gamma ray on the 100-seed weight failed to reach the significant level at 5% (Table 11). This result indicates that there was no relevance between the gamma doses and the weight of 100-seeds.

Many investigators mentioned that irradiation had no effect on 100-seed weight (El-Hossary, 1977). Others noticed that lower doses did not effect in this character (Fowler and MacQueen, 1972).

Effect of IAA on the weight of 100 seeds showed similar trend in both seasons. The presented data show a

Table (11): Effect of gamma irradiation and IAA on 100-seeds weight in 1982/83 and 1983/84 seasons.

I A A concentrations (ppm)	Gamma ray doses (K. rad)					Average of IAA
	0	1	2	4	8	
a). 1982/83 season						
0	1.95	1.93	1.94	1.89	1.82	1.90
20	1.94	1.95	1.89	1.90	1.90	1.92
40	1.93	1.54	1.87	1.66	1.67	1.73
Average of gamma ray	1.94	1.81	1.90	1.81	1.79	
L. S. D. at 5% for: IAA = 0.027 N.S., Gamma doses = 0.034 N.S., Interaction = 0.06 N.S.						
b). 1983/84 season						
0	1.88	1.89	2.01	1.93	1.79	1.90
20	1.95	1.83	1.83	1.97	1.91	1.90
40	1.81	1.79	1.90	1.79	1.88	1.83
Average of gamma ray	1.88	1.84	1.91	1.90	1.86	
L. S.D. at 5% for: IAA = N.S., Gamma doses = N.S., Interaction = N.S.						

insignificant differences due to the IAA in the first growing season only.

Whereas, the higher concentration (40 ppm) of IAA decrease 100 seeds weight compared with the 20 ppm and the untreated treatments. In this respect, El-Hossary (1977); Saleh (1978) and Atia (1986) reported that weight of 100 seeds was not significantly affected by indole acetic acid.

The effect of the interaction between gamma ray and IAA was significant on the weight of 100 seeds in the first season, only. Highest average of 100 seeds weight was obtained by the dose of 1 K. rad and 20 ppm IAA in 1982/83 season (Table 11).

6. Weight of seeds/plant :

Results presented in Table (12) indicate clearly that gamma ray doses show significant effect on the seed yield/plant in the two successive seasons.

In the first season, treating fenugreek seeds with gamma rays at 2 K. rad doses significantly increased seed yield/plant over the control. Starting from the 4 up to 8 K. rad doses, the results indicate that the weight of seeds/plant tended to decrease consistently (Table 12).

Table (12): Effect of gamma irradiation and IAA concentration on seed yield (gm)/plant at harvest during the two growing seasons of 1982/83 and 1983/84.

I A A concentrations (ppm)	Gamma ray doses (k. rad)					Average of I A A
	0	1	2	4	8	
a). 1982/83 season						
0	6.23	6.46	6.63	6.26	6.10	6.34
20	6.23	6.36	6.50	6.10	5.86	6.21
40	5.50	5.53	5.80	5.10	5.03	5.33
Average of gamma dose	5.88	6.12	6.31	5.82	5.66	
L. S.D. at 5% for: IAA = 0.208, Gamma ray = 0.269, Interaction = N.S.						
b). 1983/84 season						
0	8.63	8.76	8.36	6.96	6.50	7.84
20	8.83	8.96	8.33	6.90	6.36	7.88
40	8.26	8.56	8.43	6.83	6.10	7.64
Average of gamma ray	8.57	8.76	8.37	6.90	6.32	
L. S.D. at 5% for: IAA = N.S., Gamma ray = 0.613, Interaction = N.S.						

Similar trend was obtained in the second season, where lower doses increased seed yield/plant and higher doses decreased weight of seeds/plant.

The increases in seed yield/plant was quite expected since lower doses (1 and 2 K. rad) were associated with significant increases in number of branches/plant, number of pods/plant and 100-seed weight. These results are in harmony with those obtained by El-Hossary (1977); Hassan (1974); Saleh (1978); Tolba (1980); Atia (1981); Battah (1981) and Atia (1986).

Data in Table (12) show significant differences among the application levels of IAA in 1982/83 season, while these differences failed to reach the level of significant in 1983/84. Also, results reveal that seasonal variations in the effect of IAA were presented.

In the first season, foliar application of IAA with second rate namely 40 ppm, significantly decreased seed yield/plant. These results not agree with those obtained by El-Waziry and Abo El-Lil (1978), Saleh (1978); Atia (1981); Battah (1981) and Atia (1986).

The effect of interaction between gamma rays and IAA on the seed yield/plant was not significant. Consequently, the data were excluded (Table 12).

7. Seed yield per faddan :

Results for the effect of gamma doses on seed yield/fad. in the two experimental seasons, namely 1982/83 and 1983/84 are shown in Table (13).

The effect of gamma ray doses on the seed yield/fad. showed seasonal variation.

In the first season, the seed yield/fad. increased with increasing doses of gamma ray up to 4 K. rad,whereas, differences between all treatments of gamma ray and control failed to reach the significant level at 5%.

On the other hand, gamma ray doses significantly affected yield of seeds/fad. in the second season (Table 13). Irradiating seeds with the doses 1, 2, 4 and 8 K. rad significantly decreased the seed yield/fad. compared with the control treatment. This decrease was not expected since most of the previous characters studied showed a contradictory trend except germination (%). It should be noted that the obvious increases due to lower gamma ray doses (1 K.rad) in most of the characters studied were capable to compensate the decrease in germination (%) caused by various gamma doses. Similar trend was described by Battah (1981) and Atia (1986) on field bean plants.

Table (13): Effect of gamma irradiation and IAA concentration on seed yield/faddan (kg.) in the two seasons of 1982/83 and 1983/84.

I A A concentrations (ppm)	Gamma ray doses (k. rad)					Average of I A A
	0	1	2	4	8	
a). 1982/83 season						
0	314.4	437.4	465.6	585.3	197.76	400.11
20	276.33	156.9	472.93	267.76	463.9	327.57
40	300.23	262.16	329.23	426.73	567.43	377.18
Average of gamma ray	297.0	285.54	422.61	426.6	409.7	
L. S.D. at 5% for: IAA= N.S., gamma doses= N.S., Interaction= N.S.						
b). 1983/84 season						
0	572.73	699.86	762.16	589.36	739.8	672.78
20	689.1	633.36	553.7	715.5	656.46	649.62
40	1124.06	391.4	900.63	538.3	657.76	722.43
Average of gamma ray	795.3	574.87	738.83	614.38	684.67	
L. S.D. at 5% for: IAA=16.80, gamma doses= 21.69, Interaction =37.57						

Results of seed yield/fad., as influenced by IAA are shown in Table (13). Seed yield of fenugreek was significantly influenced by foliar application of IAA in the second season only. The application of 40 ppm increased seed yield/fad. over untreated plants. On the other hand, the first rate of 20 ppm decreased seed yield/fad. significantly as compared with the control treatment and the higher rate of IAA (40 ppm). Similar trend was observed in the first season, but the differences between treatments failed to reach the significant level at 5% (Table 13).

It could be concluded that IAA had a significant effect of seed yield/fad. at the higher rate (40 ppm). These results are expected since IAA significantly increased the number of branches/plant, number of pods/plant, 100-seed, weight and weight of seeds/plant. These results are in harmony with those obtained by Dagis and Kristitute (1963) and Atia (1986).

The interaction, gamma ray doses and IAA, effect on seed yield/fad. was significant in 1983/84 season, while in 1982/83 the effect was not significant. Highest values of the weight of seeds/fad. were obtained with foliar application of 40 ppm IAA and without exposing seeds before sowing to gamma irradiation. While, the lowest value was for 40 ppm IAA and exposing seeds at 4 K. rad.

8. Biological yield per faddan :

Data in Table (14) show that in both seasons, gamma ray doses had no significant effect on biological yield/ fad. This result indicates that there was no relevance between the gamma doses and biological yield/fad.

Foliar application of IAA did not show any significant effect on biological yield/fad. in the two successive seasons (Table 14).

Results of 1983/84 season, reveal that the combined effect of IAA and gamma ray was significant on biological yield/fad. Foliar application of 40 ppm IAA without irradiation treatment was superior in increasing biological yield/fad.

II. Chemical analysis for seeds:

1. Protein percentage :

Results in Table (15), show in both seasons, that irradiating of fenugreek seeds pre-sowing had no significant effect of protein (%) in seeds. This result indicate that there was no relevance between the gamma-ray doses and percentage of protein. These results are in harmony with results, obtained by Sharabash (1970) on onion, Fowler and Macqueen (1972) on wheat, Iqbal et al. (1972) on corn and Thabet (1985) on onion. On the contrary, Petkov et al.

Table (14): Effect of gamma irradiation and IAA concentrations on biological yield (kg.)/faddan at harvest during 1982/83 and 1983/84 season .

I A A concentrations (ppm)	Gamma ray doses (K. rad)					Average of I A A
	0	1	2	4	8	
a). 1982/83 season						
0	412.6	523.3	603.3	683.3	303.3	505.2
20	370.0	246.6	573.3	360.0	553.3	420.6
40	390.0	363.3	413.3	506.6	653.0	465.3
Average of gamma ray	390.8	377.7	530.0	516.6	503.3	
L. S. D. at 5% for: IAA = N.S., Gamma = N.S., Interaction = N.S.						
b). 1983/84 season						
0	676.6	756.6	843.3	676.6	820.0	754.6
20	766.6	723.3	643.3	803.3	743.3	736.0
40	1212.0	480.0	980.0	630.0	743.3	809.0
Average of gamma ray	885.1	653.3	822.2	703.3	768.8	
L. S. D. at 5% for: IAA = N.S., Gamma = N.S., Interaction = 332.37						

Table (15): Effect of gamma irradiation and IAA concentrations on protein percentage in seeds during 1982/83 and 1983/84.

I A A concentrations (ppm)	Gamma ray doses (K. rad)					Average of I A A
	0	1	2	4	8	
a). 1982/83 season						
0	39.06	36.40	36.56	46.25	41.25	39.90
20	39.06	42.81	41.40	45.31	42.96	42.31
40	49.06	46.71	54.28	42.90	38.68	46.30
Average of gamma ray	42.32	41.90	44.04	44.77	40.92	
L.S.D. at 5% for: Gamma ray = N.S., IAA = N.S., Interaction = N.S.						
b). 1983/84 season						
0	40.40	52.57	44.30	41.65	38.22	43.43
20	51.32	47.72	51.63	49.14	46.33	49.14
40	47.89	51.63	47.11	52.57	46.36	49.11
Average of gamma ray	46.54	50.49	47.68	47.78	43.63	
L. S.D. at 5% for: IAA = 0.79, Gamma ray = N.S., Interaction = N.S.						

(1969), Ali (1973), Shahine et al. (1974), Abo-Hegazi (1979), Tolba (1980), Atia (1981) and Atia (1986). They reported that gamma doses significantly increased the protein (%) in seeds.

Data presented in Table (15) indicate that spraying plants with IAA showed slight effect on the protein (%) in seeds. Seasonal variation in the effect of IAA was also observed.

In 1982/83 season, IAA showed no significant effect on protein (%). On the other hand, in the second season, protein percentages increased significantly by spraying with IAA as compared with the control treatment. Supporting results were reported by Hegazy et al. (1966), Atia (1981), Wale (1983) and Atia (1986).

The effect of interaction between gamma rays and IAA on the percentage of protein was not significant. Consequently, the data were excluded such result indicates that each experimental factor acted separately in affecting the protein (%) of seeds.

2. Oil - content :

Results in Table (16) show that the oil content in fenugreek seeds was not significantly influenced by gamma rays, IAA and the interaction in the two successive seasons.

Table (16): Effect of gamma irradiation and IAA concentrations on crude oil percentage in seeds during 1982/83 and 1983/84.

I A A concentrations (ppm)	Gamma ray doses (K. rad)					Average of I A A
	0	1	2	4	8	
			a). 1982/83 season			
0	8.49	8.33	8.55	9.02	8.28	8.53
20	8.15	8.23	8.28	8.37	8.77	8.36
40	8.27	8.15	8.42	8.20	8.61	8.33
Average of gamma ray	8.30	8.24	8.42	8.52	8.55	
L. S. D. at 5% for: IAA = N.S., Gamma doses = N.S., Interaction = N.S.						
			b). 1983/84 season			
0	8.15	8.92	8.69	8.73	8.46	8.59
20	8.02	8.83	8.43	9.41	8.29	8.59
40	8.93	8.15	8.76	8.72	8.60	8.63
Average of gamma ray	8.37	8.64	8.63	8.95	8.45	
L. S. D. at 5% for: IAA = N.S., Gamma doses = N.S., Interaction = N.S.						

3. Mineral - elements:

Data on the mineral-elements, i.e., Na, K and P as influenced by gamma-rays and IAA are shown in Tables (17 & 18 and 19).

a. Na - content :

Results in Table (17) indicate clearly that gamma-ray doses had no significant effect on Na-content in seeds of fenugreek in the two successive seasons. In spite of, the dose of 8 K. rad increased Na content more than the control, 2-and 4-K. rad in the first season and more than the other treatments in the second season.

In relation to the effect of IAA it may be notice that 20 ppm increased Na (%) in the 1982/83 season compared with the control treatment and 40 ppm IAA. On the other hand, increasing IAA concentration decreased the Na content in the second season. All differences failed to the significant level at 5% (Table 17).

The effect of interaction between gamma-ray doses and IAA was not significant. This result was true in the two growing season.

b. K - content :

Concerning the effect of gamma ray doses on K-content, data in Table (18) indicate that higher doses of gamma

Table (17): Effect of gamma irradiation and IAA concentrations on sodium content (mg./g. dry weight) in seeds during 1982/83 and 1983/84 seasons.

I A A concentrations (ppm)	Gamma ray doses (K. rad)					Average of I A A
	0	1	2	4	8	
a). 1982/83 season						
0	8.62	6.5	4.35	5.78	8.33	6.71
20	6.78	13.4	9.55	8.65	10.2	9.72
40	5.80	7.00	6.10	6.88	7.38	6.63
Average of gamma ray	7.07	8.96	6.66	7.10	8.63	
L. S. D. at 5% for: IAA = N.S., Gamma doses = N.S., Interaction = N.S.						
b). 1983/84 season						
0	8.60	6.10	8.20	9.45	17.38	9.49
20	9.40	6.72	11.60	8.33	9.25	9.06
40	6.40	6.37	8.18	8.70	9.93	7.92
Average of gamma ray	7.38	6.40	9.33	8.83	12.18	
L. S. D. at 5% for: IAA = N.S., Gamma doses = N.S., Interaction = N.S.						

rays increased K-content more than the control and the other doses in the both seasons, but the the differences failed to reached the significant level.

Results presented in Table (18) show that K-content was not significantly affected by spraying plants with IAA in the two seasons. Similar results were obtained by Battah (1981) and Atia (1986) on field bean.

The interaction, gamma-ray doses x IAA had no significant on the K-content in seeds of fenugreek in the two growing seasons (Table 18).

c. P - content :

The effect of gamma-ray doses on P-content in fenugreek seeds was not significant and not clear trend could be detected. These result was not agree with those obtained by Moursi et al. (1980) on snap bean, Battah (1981) and Atia (1986) on field bean. They reported that irradiation was a favoriate treatment for creating higher content of phosphorus in seeds.

Results in Table (19) show that, with increasing IAA rate the P-content in fenugreek seeds increased, but the differences failed to reach the significant level at 5%. This was true for the two growing seasons. These results

Table (18): Effect of gamma irradiation and IAA concentrations on potassium content (mg./g. dry weight) in seeds during 1982/83 and 1983/84 seasons.

I A A concentrations (ppm)	Gamma ray doses (K. rad)					Average of I A A
	0	1	2	4	8	
a). 1982/83 season						
0	32.0	26.25	32.22	27.13	39.45	31.41
20	25.82	28.13	30.95	26.88	35.18	29.39
40	27.85	28.10	32.53	32.93	32.48	30.78
Average of gamma ray	28.56	27.49	31.90	28.98	35.70	
L. S. D. at 5% for: IAA = N.S., Gamma doses = N.S., Interaction = N.S.						
b). 1983/84 season						
0	30.33	30.98	30.58	35.50	33.50	32.18
20	29.05	28.55	30.13	27.68	27.33	28.55
40	29.60	31.65	27.50	29.35	30.02	29.63
Average of gamma ray	29.66	30.39	29.40	30.84	30.28	
L. S. D. at 5% for: IAA = N.S., Gamma doses = N.S., Interaction = N.S.						

Table (19): Effect of gamma irradiation and IAA concentrations on phosphorus content (mg./g. dry weight) during 1982/83 and 1983/84 season.

I A A concentrations (ppm)	Gamma ray doses (K. rad)					Average of I A A
	0	1	2	4	8	
			a). 1982/83 season			
0	0.169	0.228	0.156	0.251	0.234	0.208
20	0.340	0.307	0.328	0.212	0.289	0.297
40	0.230	0.233	0.246	0.268	0.214	0.238
Average of gamma ray	0.246	0.256	0.244	0.244	0.249	
L. S. D. at 5% for: IAA = N.S., Gamma doses = N.S., Interaction = N.S.						
			b). 1983/84 season			
0	0.119	0.240	0.275	0.332	0.241	0.242
20	0.226	0.267	0.272	0.224	0.315	0.261
40	0.399	0.296	0.323	0.310	0.185	0.303
Average of gamma ray	0.248	0.268	0.290	0.289	0.247	
L. S. D. at 5% for: IAA = N.S., Gamma doses = N.S., Interaction = N.S.						

Table (19): Effect of gamma irradiation and IAA concentrations on phosphorus content (mg./g. dry weight) during 1982/83 and 1983/84 season.

I A A concentrations (ppm)	Gamma ray doses (K. rad)					Average of I A A
	0	1	2	4	8	
a). 1982/83 season						
0	0.169	0.228	0.156	0.251	0.234	0.208
20	0.340	0.307	0.328	0.212	0.289	0.297
40	0.230	0.233	0.246	0.268	0.214	0.238
Average of gamma ray	0.246	0.256	0.244	0.244	0.249	
L. S. D. at 5% for: IAA = N.S., Gamma doses = N.S., Interaction = N.S.						
b). 1983/84 season						
0	0.119	0.240	0.275	0.332	0.241	0.242
20	0.226	0.267	0.272	0.224	0.315	0.261
40	0.399	0.296	0.323	0.310	0.185	0.303
Average of gamma ray	0.248	0.268	0.290	0.289	0.247	
L. S. D. at 5% for: IAA = N.S., Gamma doses = N.S., Interaction = N.S.						

B. Effect of gamma irradiation and GA_3 :

I. Growth and yield:

1. Plant height:

Results for the effect of gamma radiation on plant height at different stages of growth in 1982/83 and 1983/84 seasons are given in Tables (20 and 21). Lower doses of gamma-rays had insignificant stimulating effect on plant height compared with the control treatment. Whereas, higher doses (4 and 8 K. rad) significantly inhibited fenugreek growth expressed as plant height. Similar results were obtained by El-Sayed and Wally (1977), Saleh (1978), Moursi et al (1980) and Atia (1981) and (1986).

Data presented in Tables (20 and 21) show clearly that spraying plants with GA_3 had no significant effect of plant height of fenugreek plants at different growth stages. Farrag (1971) on tomato, Abd Allah and Abd El-Rahim (1982) and Atia (1986) on field bean found contradictory results, where they reported that foliar application of GA_3 increased plant height significantly.

The effect of the interaction of gamma-rays and GA_3 on the plant height of fenugreek was not significant in the two successive seasons (Tables 20 and 21). These results did not agree with those obtained by Atia (1986) on field bean.

B. Effect of gamma irradiation and GA_3 :

I. Growth and yield:

1. Plant height:

Results for the effect of gamma radiation on plant height at different stages of growth in 1982/83 and 1983/84 seasons are given in Tables (20 and 21). Lower doses of gamma-rays had insignificant stimulating effect on plant height compared with the control treatment. Whereas, higher doses (4 and 8 K. rad) significantly inhibited fenugreek growth expressed as plant height. Similar results were obtained by El-Sayed and Wally (1977), Saleh (1978), Moursi et al (1980) and Atia (1981) and (1986).

Data presented in Tables (20 and 21) show clearly that spraying plants with GA_3 had no significant effect of plant height of fenugreek plants at different growth stages. Farrag (1971) on tomato, Abd Allah and Abd El-Rahim (1982) and Atia (1986) on field bean found contradictory results, where they reported that foliar application of GA_3 increased plant height significantly.

The effect of the interaction of gamma-rays and GA_3 on the plant height of fenugreek was not significant in the two successive seasons (Tables 20 and 21). These results did not agree with those obtained by Atia (1986) on field bean.

Table (20): Effect of gamma irradiation and GA_3 concentrations on plant height (cm.) during 1982/83 season.

GA_3 concentrations (ppm)	Gamma ray doses (K. rad) 0	1	2	4	8	Average of GA_3
a). 45 days from sowing						
0	22.6	27.2	25.1	22.3	20.4	23.5
100	24.2	28.2	25.9	22.8	19.9	24.2
200	24.6	29.0	25.6	20.4	19.1	23.7
Average of gamma dose	23.8	28.1	25.5	21.8	19.8	
L. S. D. at 5% for: GA_3 = N.S., Gamma = 1.615, and Interaction = N.S.						
b). 75 days from sowing						
0	42.7	46.4	45.7	42.6	37.8	43.0
100	48.1	48.7	49.0	41.8	38.9	45.3
200	48.6	49.7	49.5	40.3	36.7	45.0
Average of gamma doses	46.5	48.3	48.0	41.6	37.8	
L.S.D. at 5% for GA_3 = N.S., Gamma = 2.86, and Interaction = N.S.						
c). 160 days from sowing (at harvesting stage)						
0	55.0	54.1	52.0	50.7	47.7	51.9
100	51.2	50.0	48.7	46.9	45.0	48.4
200	51.6	50.6	49.7	45.5	43.7	48.2
Average of gamma doses	52.6	51.5	50.1	47.7	45.5	
L.S.D. at 5% for: GA_3 = 3.20, Gamma = 4.14, and Interaction = N.S.						

Table (21): Effect of gamma irradiation and GA_3 concentrations on plant height (cm.) during 1983/84 season.

GA_3 concentrations (ppm)	Gamma ray doses (K. rad)					Average of GA_3
	0	1	2	4	8	
a). 45 days from sowing						
0	48.9	52.4	51.2	42.7	39.5	47.0
100	50.3	53.4	54.6	49.6	48.4	51.3
20	51.0	54.4	55.0	50.4	49.0	51.9
Average of gamma doses	50.1	53.4	53.6	47.7	45.6	
L.S.D. at 5% for: GA_3 = N.S., Gamma = 5.66, and Interaction = N.S.						
b). 75 days from sowing						
0	68.5	69.3	69.8	67.6	67.3	68.5
100	72.5	69.7	70.8	66.0	65.5	68.9
200	73.6	70.6	71.4	65.1	64.6	69.0
Average of gamma doses	71.5	69.9	70.7	66.2	65.8	
L.S.D. at 5% for: GA_3 = N.S., Gamma = 2.81, and Interaction = N.S.						
c). 160 days from sowing (at harvesting stage)						
0	73.3	73.8	72.9	72.1	69.7	72.4
100	73.9	75.3	73.7	73.5	69.8	73.2
200	74.3	76.1	74.4	71.8	67.7	72.9
Average of gamma doses	73.8	75.1	73.7	72.5	69.1	
L.S.D. at 5% for: GA_3 = N.S., Gamma = N.S., and Interaction = N.S.						

2. Dry weight per plant:

The response of this character to gamma doses was very similar to the previous character (Tables 22 and 23). The dry weight/plant tended to be decreased by exposing seeds to irradiation up to 4 and 8 K. rad in the two successive seasons. This trend was expected since plant height showed the same tendency. On the other contrary, Abo El-Saod and Omeran (1975) on snap bean, Battah (1981) and Atia (1986) on field bean showed that the highest dry weight per plant was produced by exposing seeds at 5 K. rad during the two seasons.

Results in Tables (22 and 23) indicate that spraying fenugreek plants with GA_3 had no significant effect on dry weight/plant in the both seasons. These results might be due to the similar effect of GA_3 on plant height. These results did not agree with those obtained by Battah (1981) and Atia (1986) on field bean.

The effect of the interaction between gamma-rays and GA_3 on the dry weight/plant was significant at 75- and 45-day from sowing in 1982/83 and 1983/84 seasons. The heavier weight of plant was produced by control treatment for gamma rays and spraying with 200 ppm GA_3 during the two growing seasons.

Table (22): Effect of gamma irradiation and GA_3 concentrations on dry weight of shoots(g.) during 1982/83 growing season.

GA_3 concentrations (ppm)	Gamma ray doses (K. rad)					Average of GA_3
	0	1	2	4	8	
a). 45 days from sowing						
0	2.73	2.76	2.78	2.53	2.36	2.64
100	3.43	3.63	3.06	2.73	2.50	3.07
200	2.83	2.20	3.26	2.83	2.16	2.66
Average of gamma	3.00	2.86	3.04	2.70	2.34	
L. S. D. at 5% for: GA_3 = N.S., Gamma rays = N.S., Interaction= N.S.						
b). 75 days from sowing						
0	3.76	3.90	4.23	3.83	3.83	3.91
100	4.93	3.96	4.63	3.63	2.66	3.96
200	4.86	4.03	4.30	3.30	3.00	3.90
Average of gamma	4.52	3.96	4.38	3.58	3.16	
L. S. D. at 5% for: GA_3 = N.S., Gamma rays = 0.426, and Interaction = 0.738						

Table (23): Effect of gamma irradiation and GA_3 concentrations on dry weight of shoots(g.) during 1983/84 growing season.

GA_3 concentrations (ppm)	Gamma ray doses (K. rad)					Average of GA_3
	0	1	2	4	8	
a). 45 days from sowing						
0	2.86	2.76	2.74	2.43	2.30	2.62
100	2.80	3.40	2.76	2.36	2.76	2.82
200	3.06	3.46	3.63	2.66	2.26	3.02
Average of gamma	2.91	3.21	3.04	2.48	2.44	

L. S.D. at 5% for: GA_3 = 0.234, Gamma rays = 0.302, and Interaction = 0.523

b). 75 days from sowing						
0	4.53	4.76	4.56	4.36	4.06	4.46
100	4.63	4.86	4.70	4.53	4.00	4.54
200	4.76	4.90	5.43	4.36	3.93	4.68
Average of gamma	4.64	4.84	4.90	4.42	4.00	

L. S. D. at 5% for: GA_3 = N.S., Gamma rays = 0.379, and Interaction = N.S.

3. Number of branches/plant:

Results presented in Tables (24 and 25) show that the effect of gamma rays on number of branches/plant was more clear prounced at late growth stages than early stages of growth. Number of branches/plant was inversely correlated with doses of gamma rays. In other words, number of branches/plant significantly decreased with increasing doses of gamma. This was true for the two seasons. It could be concoluded that higher doses of gamma, i.e. 8 K. rad showed inhibiting effect on this character. These results did not agree with those obtained by Tolba (1980), Atia (1981), Battah (1981) and Atia (1986).

The effect of GA_3 showed significant effect on the number of branches/plant at 60- and 75- day from sowing in the first season and at 75 days from sowing in the second season (Tables 24 and 25). In general, number of branches per plant increased significantly by foliar application of GA_3 (100 ppm). On the other hand, the number of branches per plant decreased by increasing GA_3 up to 200 ppm especially in 1982/83 season. The effect of GA_3 might be attributed to the increase in the vegetative growth of fenugreek plants. Similar results were obtained by Farrag (1971) and Atia (1986).

Table (24): Effect of gamma irradiation and GA_3 concentrations on number of branches/plant during 1982/83 season.

GA_3 concentrations (ppm)	Gamma ray doses (K. rad) 0	1	2	4	8	Average of GA_3
a). 45 days from sowing						
0	1.73	2.60	1.60	2.40	2.53	2.17
100	3.40	3.40	3.80	1.93	4.07	3.32
200	2.40	3.00	4.70	2.20	1.86	2.83
Average of gamma	2.51	3.00	3.36	2.17	2.82	
L.S.D. at 5% for: GA_3= N.S., , Gamma rays = N.S., ,and Interaction =N.S.						
b). 75 days from sowing						
0	1.53	1.26	2.10	1.73	1.73	1.68
100	2.80	2.93	2.26	2.33	3.00	2.67
200	2.40	2.33	2.10	1.13	1.60	1.91
Average of gamma doses	2.24	2.17	2.17	1.73	2.11	
L.S.D. at 5% for: GA_3= 0.504, Gamma = N.S. , and Interaction = N.S.						
c). At harvest stage (160 days from sowing)						
0	3.1	2.9	2.8	2.4	2.2	2.68
100	3.1	3.2	3.3	2.4	2.0	2.80
200	2.6	3.0	3.3	1.9	1.9	2.50
Average of gamma doses	2.9	3.0	3.1	2.2	2.0	
L.S.D. at 5% for: GA_3= N.S., , Gamma rays = 0.317,and Interaction = N.S.						

Table (25): Effect of gamma irradiation and GA_3 concentrations on number of branches/plant during 1983/84 season .

GA_3 concentrations (ppm)	Gamma ray doses (K. rad) 0	1	2	4	8	Average of GA_3
a). 45 days from sowing						
0	2.23	2.33	2.10	3.00	1.30	1.99
100	2.20	2.50	1.86	1.83	1.40	1.46
200	2.16	2.23	1.76	1.93	1.10	1.84
Average of gamma doses	2.20	2.35	1.91	1.92	1.26	
L.S.D. at 5% for: GA_3= N.S., Gamma rays = .31 and Interaction = N.S						
b). 75 days from sowing						
0	5.03	4.73	4.86	4.56	3.86	4.61
100	5.13	5.03	4.23	4.23	4.03	4.53
200	4.46	4.50	3.80	3.60	3.73	4.02
Average of gamma doses	4.87	4.75	4.30	4.13	3.87	
L.S.D. at 5% for: GA_3= .26 , Gamma rays = .34 and Interaction = N.S						
c). 160 days from sowing (at harvesting stage)						
0	3.3	3.1	3.0	2.6	2.5	2.9
100	3.2	3.2	3.0	2.0	1.9	2.7
200	3.1	2.9	2.9	1.9	1.9	2.5
Average of gamma rays	3.2	3.0	2.9	2.2	2.1	
L.S.D. at 5% for = GA_3= N.S., , Gamma rays = 0.373, and Interaction = N.S.						

The effect of interaction between gamma ray doses and GA_3 on the number of branches/plant was not significant. Such result indicates that each experimental factor acted separately in affecting the growth of fenugreek.

4. Number of pods/plant:

Results in Tables (26 and 27) show that the number of pods/plant was significantly affected with gamma rays. In the first season, number of pods/plant significantly decreased with increasing doses of gamma up to 4 K. rad compared with the other treatments at 60 days from sowing. Similar trend was observed in the second season, since increasing gamma doses decreased the number of pods/plant at different growth stages (Tables 26 and 27). On the contrary, Atia (1986) found that exposing seeds before sowing to gamma irradiation more than $\frac{1}{2}$ K. rad during the first season and 1 K. rad in the second season significant increased the number of pods/plant at harvest compared to the other treatments.

The effect of spraying GA_3 on the number of pods/plant was significant at 75 days and 60 days from sowing in the first and second seasons (Tables 26 and 27). Foliar application of GA_3 first rate namely, 100 ppm, significantly increased number of pods/plant. On the other hand, applying 200 ppm of GA_3 decreased the number of pods/plant. These

Table (26): Effect of gamma irradiation and GA_3 on the number of pods/plant during 1982/83 season.

GA_3 concentrations (ppm)	Gamma ray doses (K. rad) 0	1	2	4	8	Average of GA_3
a). 45 days from sowing						
0	0.33	0.93	0.66	1.00	0.80	0.75
100	1.06	0.87	1.20	1.03	0.87	1.01
200	1.13	0.63	0.80	0.67	0.93	0.83
Average of gamma rays	0.84	0.81	0.89	0.90	0.87	
L.S.D. at 5% for: GA_3=N.S., , Gamma rays = N.S. and Interaction = N.S.						
b). 60 days from sowing						
0	3.87	4.53	3.20	2.67	4.07	3.67
100	5.10	3.86	4.26	3.93	4.13	4.26
200	3.00	2.60	3.60	1.80	3.67	2.93
Average of gamma rays	3.99	3.67	3.69	2.80	3.96	
L.S.D. at 5% for: GA_3=N.S, , Gamma rays = 0.23, and Interaction = N.S.						
c). 75 days from sowing						
0	3.13	1.93	3.87	3.20	3.33	3.09
100	4.00	4.66	5.60	4.63	7.53	5.27
200	5.73	4.07	4.50	2.13	4.13	4.11
Average of gamma doses	4.29	3.56	4.66	3.32	5.00	
L.S.D. at 5% for: GA_3= 1.207, Gamma rays = N.S. and Interaction = N.S.						

Table (27): Effect of gamma irradiation and GA_3 on the number of pods/plant during 1983/84 season.

GA_3 concentrations (ppm)	Gamma ray doses (K. rad) 0	1	2	4	8	Average of GA_3
a). 45 days from sowing						
0	1.53	1.20	0.90	0.70	0.70	1.00
100	1.00	1.30	1.00	0.80	0.63	0.94
200	1.43	1.20	0.90	0.73	0.63	0.98
Average of gamma doses	1.30	1.23	0.93	0.74	0.65	
L.S.D. at 5% for: GA_3=N.S., Gamma rays = 0.23, and Interaction=N.S.						
b). 60 days from sowing						
0	5.53	5.76	6.06	5.20	4.66	5.44
100	5.20	5.63	5.00	5.40	4.73	5.19
200	5.06	5.06	4.76	3.73	3.83	4.49
Average of gamma doses	5.26	5.48	5.27	4.77	4.41	
L.S.D. at 5% for: GA_3= 0.31, Gamma rays = 0.41, and Interaction = N.S.						
c). 75 days from sowing						
0	6.30	5.56	5.43	4.73	4.06	5.22
100	6.53	6.23	5.50	4.16	3.76	5.24
200	5.63	6.13	5.73	4.63	3.46	5.12
Average of gamma doses	6.15	5.97	5.55	4.51	3.76	
L.S.D. at 5% for: GA_3= N.S., , Gamma rays = 0.47, and Interaction = N.S.						

results might be attributed to the significant effect of GA_3 on the number of branches/plant. These results agree with those reported by El-Waziry and Abo-El-lil (1978), Battah (1981), Atia (1986) on field bean and Baza (1985) on soybean.

The effect of the interaction between gamma rays doses and GA_3 on this character was not significant (Tables 26 and 27). These results did not agree with those obtained by Atia (1986) on field bean. Who reported that the greatest values of number of pods/plant were obtained at 2 K. rad x 150 ppm GA_3 in the first season and 5 K. rad x 75 ppm GA_3 in the second season.

5. Weight of 100 seeds:

Data presented in Table (28) show significant differences among the doses of gamma ray in 1982/83 season, while these differences failed to reach the level of significance in 1983/84 season. Also, results reveal that seasonal variations in the effect of gamma rays were observied. In the first season, the doses of 2 K. rad significantly increased weight of 100-seed over the control. The height radiation dose, i.e., 4 and 8 K. rad significantly reduced 100 seeds weight compared with the other treatments (Table 28). These result not agree with those obtained by El-Hossary (1977), Saleh (1978), Battah (1981) and Atia (1986) on field bean.

Table (28): Effect of gamma irradiation and GA_3 on weight of 100 seeds during1982/83 and 1983/84 seasons

GA_3 concentrations (ppm)	Gamma ray doses (K. rad)					Average of GA_3
	0	1	2	4	8	
a). 1982/83 season						
0	1.95	1.93	1.94	1.89	1.82	1.90
100	1.89	1.93	1.88	1.70	1.42	1.76
200	1.58	1.63	1.88	1.61	1.65	1.67
Average of gamma doses	1.81	1.83	1.90	1.73	1.63	
L.S.D. at 5% for: GA_3= 0.04, Gamma rays = 0.06, and Interaction = 0.11						
b). 1983/84 season						
0	1.88	1.89	2.01	1.93	1.79	1.90
100	1.80	1.98	1.95	1.83	1.88	1.89
200	1.66	1.76	1.80	1.59	1.94	1.75
Average of gamma doses	1.78	1.87	1.92	1.78	1.87	
L.S.D. at 5% for: GA_3= N.S., Gamma rays = N.S., Interaction = N.S.						

Foliar application of GA_3 significantly decreased weight of 100 seeds in the first season as compared with control treatment. The same rate gave an insignificant decrease in the second season. It could be concluded that 100-seed weight was inversely correlated with GA_3 application. Many investigators studied the effect of spraying of GA_3 on weight of 100 seeds of legumes crops. El-Hossary (1977), Saleh (1978), Battah (1981) and Atia (1986) on field bean, reported that spraying plants with GA_3 had no significant effect on averages of seed weight. On the other hand, Baza (1985) on soybean found that foliar application of 50 ppm GA_3 increased significantly weight of 100 seeds in one season only.

The effect of the interaction gamma rays and GA_3 was significant on the weight of 100 seeds in the first season only. The lowest weight of 100-seed was obtained at 8 K. rad and 100 ppm GA_3 in 1982/83 season (Table 28).

6. Weight of seeds per plant:

Data presented in Table (29) indicate that the effect of gamma ray doses on the weight of seeds/plant showed seasonal variations. In 1982/83 season, gamma rays did not show significant effect on seeds weight/plant, where the differences in the weight of seeds/plant failed to reach the significant level (Table 29). Whereas, in 1983/84

Table (29): Effect of gamma irradiation and GA_3 concentrations on seed yield/plant (g.) at harvest during 1982/83 and 1983/84 season .

GA_3 concentrations (ppm)	Gamma ray soses (K. rad)					Average of GA_3
	0	1	2	4	8	
a). 1982/83 season						
0	6.23	6.46	6.63	6.26	6.10	6.34
100	6.40	6.46	6.86	6.36	6.43	6.50
200	6.56	6.73	6.90	6.23	6.93	6.67
Average of gamma doses	6.40	6.55	6.80	6.28	6.48	
L.S.D. at 5% for: GA_3 = N.S., Gamma rays = N.S., and Interaction = N.S.						
b). 1983/84 season						
0	8.76	8.76	8.36	6.96	6.50	7.87
100	9.13	9.30	9.90	9.76	9.46	9.51
200	9.43	9.93	10.00	9.70	9.16	9.64
Average of gamma doses	9.11	9.33	9.42	8.81	8.37	
L.S.D. at 5% for: GA_3= 0.314, Gamma rays = 0.406, and Interaction = 0.703						

season, the lowest radiation dose, i.e., 1 and 2 K. rad increased the weight of seeds/plant compared with the control. On the other hand, the highest dose significantly reduced this character compared with control plants. Such results are expected, since lower radiation treatments increased number of branches/plant as well as number of pods/plant. These result did not agree with those obtained by Tolba (1980), Atia (1981), Battah (1981) and Atia (1986) on field bean.

Data illustrated in Table (29) show that weight of seeds/plant significantly increased by spraying plants with GA_3 in the second season only. In that season, increasing GA_3 up to 100 or 200 ppm significantly increased weight of seeds/plant than the untreated plants. These results might be attributed to the effect of GA_3 on the number of branches/plant, number of pods/plant and weight of 100 seeds. These results are in harmony with those obtained by Battah (1981), Abd Allah and Abd El-Rahim (1982) and Atia (1986) on field bean.

The effect of the interaction gamma rays x GA_3 on the weight of seeds/plant was significant in the 1983/84 season only. The highest seed yield/plant was obtained at 2 K. rad and 40 ppm GA_3, while the lowest value was obtained at 8 K. rad and without application of GA_3. Similar results were obtained by Atia (1986).

7. Seed yield per faddan:

Results in Table (30) show that the effect of gamma-ray doses on the seed yield/fad. showed seasonal variations. In first season, seed yield/fad. tended to increase by irradiation at 2 and 4 K. rad as compared with the control treatment. Moreover, higher doses of gamma ray, i.e., 8 K. rad decreased the yield/fad. All differences failed to reach the significant level (Table 30). In the second season, radiation treatments showed significant effect on seed yield/fad. The highest seed yield was obtained at 2 K. rad dose. On the other hand, higher doses, namely, 4 and 8 K. rad significantly reduced the seed yield/fad. (Table 30). It could be concluded that lower gamma ray doses increased yield components characters and that led in turn to an increase in seed yield. On the contrary, higher doses decreased these previous characters and consequently reduced significantly seed yield. These results are harmony with those obtained by Battah (1981) and Atia (1986).

Seed yield of fenugreek was significantly influenced by foliar application of GA_3 in the two successive seasons (Table 30). The application of GA_3 showed no particular trend in the both seasons. In the first season, increasing rate of GA_3 significantly decreased seed yield/faddan compared with untreated plants. On the contrary, seed yield/fad. significantly increased with increasing GA_3 up to

Table (30): Effect of gamma irradiation and GA_3 on seed yield per faddan (kg.) at harvest during 1982/83 and 1983/84 seasons.

GA_3 concentrations (ppm)	Gamma ray doses (K. rad)					Average of GA_3
	0	1	2	4	8	
a). 1982/83 season						
0	314.4	437.4	542.9	585.3	205.5	417.10
100	302.0	315.96	214.7	246.76	253.36	266.56
200	296.56	200.36	234.46	179.8	475.23	277.28
Average of gamma doses	304.33	317.91	330.68	337.28	311.36	
L.S.D. at 5% for: GA_3= 25.65, Gamma rays = N.S. and Interaction = 57.37						
b). 1983/84 season						
0	572.73	699.86	762.16	589.36	739.80	672.78
100	469.36	737.53	869.66	364.06	638.80	615.88
200	949.73	747.60	1122.50	422.56	726.76	793.83
Average of gamma doses	663.94	728.33	918.11	458.66	701.78	
L.S.D. at 5% for: GA_3= 62.96, Gamma rays = 81.29, and Interaction = 140.80						

200 ppm in the second season (Table 30). It could be concluded that the effect of GA_3 on seed yield/fad. showed no particular trend could be detected in the two successive seasons. These results did not agree with those obtained by Atia (1986). Who reported that the averages of seed yield per unit area were not significantly affected by spraying GA_3.

Results in Table (30) indicate that the effect of the interaction between gamma rays and GA_3 showed significant effect on seed yield/fad. in the two seasons. The highest seed yield/fad. was obtained at 4 K. rad and untreated plants with GA_3 in the first season and at 2 K. rad and 200 ppm GA_3 in the second season.

8. Biological yield per faddan:

The present data showed that biological yield/fad. was not significantly influenced by gamma ray doses in the two successive seasons (Table 31).

The response of this character to spraying of GA_3 was very similar to the previous character (seed yield/fad.). The highest biological yield was obtained from untreated plants with GA_3 in the first season and from 200 ppm GA_3 in the seccnd season (Table 31).

Table (31): Effect of gamma irradiation and GA_3 concentrations on biological yield/faddan (kg.) at harvest stage during 1982/83 and 1983/84 seasons.

GA_3 concentrations (ppm)	Gamma ray doses (K. rad)					Average of GA_3
	0	1	2	4	8	
a). 1982/83 season						
0	410.0	523.3	603.3	683.3	303.3	505.2
100	406.6	410.0	306.6	336.6	336.6	365.3
200	416.6	310.0	353.3	300.0	596.6	395.3
Average of gamma doses	412.0	414.4	421.1	440.0	422.2	
L.S.D. at 5% for: GA_3= 79.07, Gamma rays = N.S., and Interaction = 250.05						
b). 1983/84 season						
0	676.6	756.6	843.3	676.6	820.0	754.6
100	573.3	830.0	576.6	473.3	610.0	612.6
200	1050.0	846.6	1203.3	520.0	703.3	864.6
Average of gamma doses	766.6	811.1	874.4	556.6	711.1	
L.S.D. at 5% for: GA_3= 187.39, Gamma rays = N.S., and Interaction = N.S.						

The effect of gamma ray doses x GA_3 on biological yield was significant in the first season only (Table 31). Gamma ray doses of 4 K. rad without spraying of GA_3 was superior in increasing biological yield/fad.

II. Chemical analysis for seeds:

1. Protein percentages:

Results showed that there was no relevance between gamma rays, GA_3 as well as the combined effect and the protein (%) in the both seasons (Table 32). These result was not similar with those obtained by Abo-Hegazi (1979), Tolba (1980) and Atia (1981) and (1986). They reported that gamma ray doses significantly increased protein (%) in seeds. Moreover, Battah (1981) and Atia (1986), found that spraying field bean plants with GA_3 significantly increased protein (%) in seeds.

2. Oil content:

The effect of gamma ray doses was not significant on the oil (%) in the two successive seasons (Table 33).

With respect, the effect of GA_3 on the oil (%) was significant only in the first season (Table 33). Increasing rate of GA_3 up to 200 ppm significantly decreased oil

Table (32): Effect of gamma irradiation and GA_3 concentrations on protein percentage in seeds at harvest during 1982/83 and 1983/84 seasons.

a). 1982/83 season

0	38.84	36.34	36.50	46.17	41.18	39.90
100	41.34	37.90	46.17	36.81	46.80	41.80
200	51.48	45.39	41.49	43.68	51.48	46.70
Average of gamma doses	43.88	39.88	41.39	42.22	46.48	

L.S.D. at 5% for: GA_3 = N.S., Gamma rays = N.S., and Interaction = N.S.

b). 1983/84 season

0	40.40	52.57	44.30	41.65	38.22	43.43
100	45.86	46.80	40.71	46.95	43.05	44.67
200	44.77	46.17	40.24	50.07	53.04	46.86
Average of gamma doses	43.68	48.51	41.75	46.22	44.77	

L.S.D. at 5% for: GA_3 = N.S., Gamma rays = N.S., and Interaction = N.S.

Table (33): Effect of gamma irradiation and GA_3 concentrations on oil percentages in seeds at harvest during 1982/83 and 1983/84 seasons.

GA_3 concentrations (ppm)	Gamma ray doses (K. rad)					Average of GA_3
	0	1	2	4	8	
a). 1982/83 season						
0	8.49	8.33	8.55	9.02	8.28	8.53
100	8.86	8.43	7.97	8.38	7.82	8.29
200	8.17	7.50	7.86	8.62	7.86	8.00
Average of gamma doses	8.51	8.08	8.13	8.68	7.98	
L.S.D. at 5% for: GA_3= 0.387, Gamma rays = N.S., and Interaction = N.S.						
b). 1983/84 season						
0	8.15	8.92	8.69	8.73	8.46	8.59
100	8.62	8.37	8.55	8.99	8.46	8.59
200	8.67	8.34	8.51	8.30	8.88	8.54
Average of gamma doses	8.48	8.54	8.58	8.67	8.60	
L.S.D. at 5% for: GA_3= N.S., Gamma rays = N.S. and Interaction=N.S.						

(%) in the seeds. Similar results were obtained by Baza (1985). Who reported that oil content in soybean seeds was not significantly affected by different levels of GA_3 in the two successive seasons.

3. Mineral elements :

1. Na - content:

Results in Table (34) indicate that the effect of gamma ray and spraying of GA_3 on Na-content in seeds of fenugreek were not significant in the two successive seasons.

The effect of interaction between gamma doses and GA_3 was significant on the Na-content in the second season only. The highest Na-content was obtained at 4 K. rad and 200 ppm GA_3.

2. P - content:

Data in Table (35) show that in both seasons, gamma rays, GA_3 and the interaction had no significant effect on the P-content in seeds. This result indicates that there was no relavance between these factors and content of phosphorus in seeds of fenugreek. These result was not harmony with those obtained by Moursi et al. (1980), Battah (1981) and Atia (1986). They reported that exposing seeds before sowing to gamma irradiation more than $\frac{1}{2}$ and 3 K. rad in the first and second season increased significantly P (%) as compared with other treatments.

Table (34): Effect of gamma irradiation and GA_3 concentrations on Na content (mg/g.) in seeds at harvest during 1982/83 and 1983/84 seasons

GA_3 concentrations (ppm)	Gamma ray doses (K. rad)					Average of GA_3
	0	1	2	4	8	
a). 1982/83 season						
0	8.63	6.50	4.35	5.78	8.33	6.72
100	6.58	8.88	12.70	7.65	5.83	8.33
200	5.70	6.95	6.85	6.70	5.35	6.31
Average of gamma doses	6.97	7.44	7.97	6.71	6.60	
L.S.D. at 5% for: GA_3= N.S., Gamma rays = N.S., and Interaction = N.S.						
b). 1983/84 season						
0	6.35	6.10	8.20	9.45	17.37	9.49
100	12.22	8.63	7.65	8.05	4.00	8.11
200	8.12	8.47	8.45	13.97	7.25	9.23
Average of gamma doses	8.90	7.73	8.10	10.49	9.54	
L.S.D. at 5% for: GA_3= N.S., Gamma rays = N.S., and Interaction = 6.18						

Table (35): Effect of gamma irradiation and GA_3 concentrations on P - content (mg/g.) in seeds at harvest stage during 1982/83 and 1983/84 seasons.

GA_3 concentrations (ppm)	Gamma ray doses (K. rad)					Average of GA_3
	0	1	2	4	8	
a). 1982/83 season						
0	0.169	0.228	0.156	0.251	0.234	0.208
100	0.308	0.278	0.262	0.265	0.188	0.260
200	0.258	0.191	0.290	0.262	0.297	0.259
Average of gamma doses	0.245	0.232	0.236	0.259	0.239	
L.S.D. at 5% for: GA_3= N.S., Gamma rays = N.S., and Interaction = N.S.						
b). 1983/84 season						
0	0.119	0.240	0.275	0.332	0.238	0.241
100	0.198	0.258	0.227	0.329	0.229	0.248
200	0.366	0.220	0.384	0.308	0.284	0.313
Average of gamma doses	0.228	0.239	0.295	0.323	0.251	
L.S.D. at 5% for: GA_3= N.S., Gamma rays = N.S., and Interaction = N.S.						

On the other hand, spraying GA_3 significantly decreased P (%) in the two seasons (Battah, 1981 and Atia, 1986).

3. K - content:

Results in Table (36) show that gamma doses or GA_3 were not significantly effected on K-content in seeds. Similar results were obtained by Moursi et al. (1980), Battah (1981) and Atia (1986).

Table (36): Effect of gamma irradiation and GA_3 concentrations on K - content (mg/g.) in seeds at harvest stage during 1982/83 and 1983/84 seasons.

GA_3 concentrations (ppm)	Gamma ray doses (K. rad)					Average of GA_3
	0	1	2	4	8	
a). 1982/83 season						
0	32.0	26.25	32.22	27.13	39.45	31.41
100	29.1	28.40	32.90	28.90	29.40	29.74
200	33.70	32.70	31.80	34.20	32.30	32.94
Average of gamma doses	31.60	29.10	32.30	30.06	33.73	
L.S.D. at 5% for: GA_3= N.S., Gamma rays = N.S., and Interaction = N.S.						
b). 1983/84 season						
0	30.33	30.98	30.58	35.50	33.50	32.18
100	27.75	30.00	28.05	29.95	28.30	28.81
200	29.93	30.13	27.45	30.83	39.00	31.47
Averge ofgamma doses	29.33	30.36	28.69	32.09	33.60	
L.S.D. at 5% for: GA_3= N.S., Gamma rays = N.S., and Interaction = N.S.						

Third Part : Field Experiment :

Effect of IAA or GA_3 concentrations and their number of applications :

I. Growth and yield :

1. Plant height :

Results presented in Table (37) show that plant height of fenugreek at harvesting stages was not significantly affected with concentration of IAA, number of spraying and the its interaction. This was true for the two growing seasons. These results indicates that there was no relavance between the previous factors and plant height.

The effect of GA_3, number of spraying and their interaction on plant height were similar to the effect of IAA except in the first season. Foliar application of GA_3 significantly increased the height of fenugreek plants. However, the second rate of GA_3 (200 ppm) was more effective in this respect than the control as well as the first rate treatments.

2. Dry weight/plant :

Results in Tables indicate that the effect of spraying number of IAA on dry weight/plant showed seasonal variation. In 1982/83 season, increasing the number of spraying decreased the dry weight/plant. Spraying plants once time by IAA produced higher dry weight/plant (Table 42).

Table (37): Effect of spraying plants once time by IAA or GA_3 on some growth character .

Growth Regulators	Concentrations (ppm)	Plant height (cm.)	No. of branches per plant	Number of pods/plant	Dry weight/plant (gm.)
		a). 1982/83 season			
I A A	0	9.96	1.00	0.47	0.12
	20	14.63	1.10	0.23	0.21
	40	13.23	1.20	0.34	0.13
L.S.D. at 5% :		N.S.	N.S.	N.S.	N.S.
GA_3	0	9.96	1.0	0.47	0.12
	100	15.53	1.0	0.19	0.12
	200	14.26	1.10	0.21	0.18
L. S. D. at 5%:		N.S.	N.S.	N.S.	N.S.
		b). 1983/84 season			
I A A	0	25.17	1.10	0.31	0.16
	20	26.95	1.00	0.27	0.15
	40	26.43	1.30	0.19	0.14
L. S. D. at 5% :		N.S.	0.134	0.023	N.S.
GA_3	0	25.17	1.10	0.31	0.16
	100	25.63	1.00	0.21	0.13
	200	27.37	1.20	0.18	0.19
L. S. D. at 5% :		N.S.	N.S.	0.041	N.S.

Table (38): Effect of two spraying times and concentrations of IAA or GA_3 on growth characters of plants during 1982/83 season.

Growth Regulators	Conc. (ppm)	Plant height (cm.)			Number of branches/plant			Number of pods/plant			Dry weight/plant (gm.)		
		Sprays numbers											
		1	2	Mean	1	2	Mean	1	2	Mean	1	2	Mean
I A A	0	32.1	32.8	34.4	2.80	1.00	1.80	1.66	0.86	1.26	0.60	0.43	0.51
	20	32.2	31.6	31.9	1.86	2.33	2.10	1.26	1.06	1.16	0.43	0.42	0.43
	40	31.8	30.9	31.3	2.30	2.30	2.30	1.66	1.46	1.56	0.36	0.47	0.42
	Mean	32.0	31.8		2.22	1.84		1.53	1.13		0.46	0.44	
L.S.D. at 5% for IAA:		N.S.			N.S.			N.S.			N.S.		
L.S.D. at 5% for sprays No.:		N.S.			N.S.			N.S.			N S.		
L.S.D. at 5% for Interaction:		N.S.			N.S.			N.S.			N.S.		
GA_3	0	32.1	32.8	32.4	2.80	1.00	1.80	1.66	0.86	1.26	0.60	0.43	0.51
	100	34.9	38.3	36.6	1.46	2.13	1.80	1.66	1.86	1.76	0.39	0.62	0.50
	200	36.6	36.2	36.4	1.90	1.83	1.86	1.40	1.60	1.50	0.29	0.41	0.35
	Mean	34.5	35.7		1.98	1.65		1.57	1.44		0.43	0.48	
L.S.D. at 5% for IAA :		N.S.			N.S.			N.S.			N.S.		
L.S.D. at 5% for sprays No.:		N.S.			N.S.			N.S.			N.S.		
L.S.D. at 5% for Interaction:		N.S.			N.S.			N.S.			N.S.		

Table (39): Effect of two spraying times and concentrations of IAA or GA_3 on growth characters of plants during 1983/84 season.

Growth Regulators	Conc. (ppm)	Plant height (cm.)			Number of branches/plant			Number of pods/plant			Dry weight/plant (gm.)		
					Sprays			number					
		1	2	Mean	1	2	Mean	1	2	Mean	1	2	Mean
IAA	0	56.6	56.3	56.4	2.10	1.90	2.00	1.61	1.09	1.35	0.42	0.47	0.44
	20	61.4	57.4	59.4	1.90	2.30	2.10	1.45	1.67	1.61	0.49	0.39	0.44
	40	61.2	60.0	60.6	2.00	2.10	2.10	1.48	1.67	1.75	0.42	0.50	0.46
	Mean	59.7	57.9		2.00	2.10		1.51	1.51		0.44	0.45	
L.S.D. at 5% for IAA :		N.S.			0.060			0.039			N.S.		
L.S.D. at 5% for sprays No.:		N.S.			0.049			N.S.			N.S.		
L.S.D. at 5% for Interaction:		N.S.			0.085			0.055			N.S.		
GA_3	0	56.6	56.3	56.4	2.10	1.90	2.00	1.61	1.09	1.35	0.42	0.47	0.44
	100	53.4	61.5	57.5	2.10	2.20	2.10	1.86	1.74	1.80	0.49	0.60	0.54
	200	55.4	58.8	57.1	2.00	2.40	2.20	1.51	1.43	1.47	0.55	0.47	0.51
	Mean	55.1	58.8		2.10	2.16		1.66	1.42		0.48	0.51	
L.S.D. at 5% for IAA :		N.S.			N.S.			0.048			0.012		
L.S.D. at 5% for sprays number:		N.S.			N.S.			0.039			0.010		
L.S.D. at 5% for Interaction:		N.S.			0.275			0.068			0.018		

Table (40): Effect of three spraying times and concentrations of IAA or GA_3 on growth characters in 1982/83 season.

Growth Regulators	Conc. (ppm)	Plant height (cm.)				Number of branches/plant				Number of pods/plant				Dry weight/plant (gm.)			
		Sprays numbers															
		1	2	3	Mean	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean
I A A	0	42.3	43.4	44.9	43.5	2.26	2.13	2.60	2.33	3.33	3.26	3.80	3.46	0.77	0.74	0.93	0.81
	20	41.7	41.0	45.4	42.7	2.13	2.63	2.66	2.47	4.00	3.56	3.80	3.78	0.85	0.79	1.01	0.88
	40	42.4	44.8	39.7	42.3	2.73	2.40	1.86	2.33	4.80	2.66	2.66	3.37	1.16	0.69	0.83	0.89
	Mean	42.1	43.1	43.3		2.37	2.38	2.37		4.04	3.16	3.42		0.93	0.74	0.92	
L.S.D. at 5% IAA =		N.S.				N.S.				N.S.				N.S.			
L.S.D.at 5% sprays No.=		N.S.				N.S.				N.S.				N.S.			
L.S.D.at 5% Interaction=		N.S.				N.S.				N.S.				N.S.			
GA_3	0	42.3	43.4	44.9	43.5	2.26	2.13	2.60	2.33	3.33	3.26	3.80	3.46	0.77	0.74	0.93	0.81
	100	41.0	47.4	49.2	45.8	2.83	1.73	2.50	2.35	5.30	3.20	3.50	4.00	0.94	0.80	0.75	0.83
	200	44.9	43.9	49.5	46.0	2.46	2.00	2.86	2.44	4.00	3.13	3.13	3.42	0.74	0.88	1.10	0.91
	Mean	42.7	44.8	47.9		2.52	1.95	2.65		4.21	3.20	3.47		0.81	0.81	0.93	
L.S.D. at 5% GA_3 =		N.S.				N.S.				N.S.				N.S.			
L.S.D. at 5% sprays No. =		3.13				N.S.				N.S.				N.S.			
L.S.D. at 5% Interaction=		5.42				N.S.				N.S.				N.S.			

Table (41): Effect of three spraying times and concentrations of IAA or GA_3 on growth characters in 1983/84 season.

Growth Regulators	Conc. (ppm)	Plant height (cm.)				Number of branches/plant				Number of pods/plant				Dry weight/plant (gm.)			
		Sprays numbers															
		1	2	3	Mean	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean
I A A	0	67.7	69.0	67.3	68.0	1.90	2.00	2.10	2.00	3.61	3.57	3.84	3.67	0.91	0.98	0.94	0.94
	20	61.6	70.0	61.7	64.5	2.10	2.00	1.90	2.00	3.81	2.42	3.65	3.29	0.69	0.78	0.45	0.64
	40	73.7	71.8	73.0	72.8	2.30	3.10	2.90	2.76	2.92	4.14	2.59	3.21	1.69	0.70	0.62	1.00
	Mean	67.7	70.3	67.3		2.10	2.36	2.30		3.44	3.38	3.36		1.09	0.82	0.67	
L.S.D. at 5% IAA =		N.S.				0.09				0.020				0.018			
L.S.D. at 5% sprays No.=		N.S.				0.10				0.023				0.018			
L.S.D. at 5% Interaction=		N.S.				0.17				0.040				0.031			
GA_3	0	67.7	69.0	67.3	68.0	1.90	2.00	2.10	2.00	3.61	3.57	3.84	3.67	0.91	0.98	0.94	0.94
	100	66.2	65.5	64.7	65.4	2.90	2.10	2.80	2.60	2.68	5.53	4.61	4.27	0.93	1.03	1.11	1.02
	200	75.6	70.6	68.2	71.5	2.20	2.40	3.10	2.56	4.92	4.36	5.71	4.99	0.95	1.20	0.84	0.99
	Mean	69.8	68.4	66.7		2.33	2.16	2.66		3.73	4.48	4.72		0.93	1.07	0.96	
L.S.D. at 5% GA_3 =		N.S.				0.09				0.52				0.015			
L.S.D. at 5% sprays No.=		N.S.				0.10				0.52				0.015			
L.S.D. at 5% Interaction=		N.S.				0.17				0.90				0.026			

Table (42): Effect of spraying four times and concentrations of IAA or GA_3 on growth characters in 1982/83 season.

Growth Regulators	Conc. (ppm)	Plant height (cm.)					Number of branches/plant					Number of pods/plants					Dry weight/plant (gm.)				
		Sprays					Sprays					numbers									
		1	2	3	4	Mean	1	2	3	4	Mean	1	2	3	4	Mean	1	2	3	4	Mean
IAA	0	45.1	42.0	47.7	47.9	45.6	3.00	2.73	2.60	3.73	3.01	3.93	3.66	4.13	6.66	4.60	0.92	0.72	0.86	1.14	0.91
	20	41.3	42.6	43.6	43.4	42.7	2.40	1.40	2.40	1.66	1.96	4.26	2.40	3.80	3.80	3.56	0.64	0.53	0.78	0.66	0.65
	40	53.8	43.7	48.1	43.8	47.3	3.60	2.93	3.00	1.53	2.76	7.00	5.00	4.40	2.80	4.80	1.61	1.25	0.97	0.74	1.14
	Mean	46.7	42.8	46.4	45.0		3.00	2.35	2.66	2.31		5.06	3.68	4.11	4.42		1.06	0.83	0.87	0.85	
L.S.D. at 5% IAA =		N.S.					N.S.					N.S.					0.37				
L.S.D. at 5% sprays No.=		N.S.					N.S.					N.S.					N.S.				
L.S.D. at 5% Interaction=		N.S.					N.S.					N.S.					N.S.				
GA_3	0	45.1	42.0	47.7	47.9	45.6	3.00	2.73	2.60	3.73	3.01	3.93	3.66	4.13	6.66	4.60	0.92	0.72	0.86	1.14	0.91
	100	41.6	52.6	51.6	52.9	49.7	2.46	2.13	2.53	4.26	2.60	4.13	4.46	4.53	4.13	4.31	0.84	1.04	1.28	1.19	1.09
	200	47.0	44.4	50.4	50.2	48.0	3.06	2.26	3.46	4.26	3.26	4.73	5.40	4.43	6.86	5.35	1.38	1.19	1.20	2.13	1.48
	Mean	44.5	46.3	49.9	50.3		2.84	2.37	2.86	3.76		4.26	4.51	4.36	5.88		1.05	0.98	1.11	1.49	
L.S.D. at 5% for GA_3 =		N.S.					N.S.					N.S.					0.45				
L.S.D. at 5% for sprays No.=		5.25					N.S.					N.S.					N.S.				
L.S.D. at 5% for Interaction=		N.S.					N.S.					N.S.					N.S.				

Table (43): Effect of spraying four times and concentrations of IAA or GA_3 on growth characters in 1983/84 season.

Growth Regulators	Conc. (ppm)	Plant height (cm.)					Number of branches/plant					Number of pods/plant					Dry weight/plant (gm.)				
		Sprays					Sprays					numbers									
		1	2	3	4	Mean	1	2	3	4	Mean	1	2	3	4	Mean	1	2	3	4	Mean
IAA	0	57.3	68.2	72.2	70.0	66.9	2.7	3.0	3.1	2.9	2.9	4.53	4.47	4.93	5.47	4.85	0.95	0.99	0.97	1.10	1.00
	20	71.6	77.6	63.5	66.9	69.9	2.9	3.1	3.0	2.8	2.9	3.29	4.78	3.56	4.38	4.00	0.90	0.81	0.60	0.97	0.78
	40	66.3	71.2	72.2	75.4	71.3	2.8	2.9	2.8	4.1	3.4	5.57	3.49	3.46	4.12	4.16	1.40	0.95	0.85	0.91	1.02
	Mean	65.0	72.3	69.3	70.8		2.8	3.0	3.3	3.2		4.46	4.24	3.98	4.65		0.92	0.91	0.80	0.99	
L.S.D. at 5% for I A A =		N.S.					0.10					0.042					0.14				
l.s.d. at 5% for sprays No.=		N.S.					0.12					0.048					0.16				
L.S.D. at 5% for Interaction=		N.S.					0.20					0.084					0.28				
	0	57.3	68.2	72.2	70.0	66.9	2.7	3.0	3.1	2.9	2.9	4.53	4.47	4.93	5.47	4.85	0.95	0.99	0.97	1.10	1.00
	100	68.3	72.0	67.8	71.6	69.9	3.0	3.1	2.9	3.8	3.2	4.72	4.68	5.76	5.26	5.10	2.12	2.40	1.23	1.17	1.73
	200	68.1	72.3	71.7	69.5	70.4	3.1	2.9	3.2	4.1	3.3	5.71	5.14	6.06	5.53	5.61	2.09	1.84	2.23	1.74	1.97
	Mean	64.5	70.8	70.6	70.4		2.9	3.0	3.0	3.6		4.98	4.76	5.58	5.42		1.72	1.74	1.47	1.33	
L.S.D. at 5% for GA_3 =		N.S.					0.10					0.071					0.01				
L.S.D. at 5% for sprays No.=		N.S.					0.12					0.082					0.01				
L.S.D. at 5% for Interaction=		N.S.					0.20					0.143					0.02				

Table (44): Effect of spraying repetation and IAA on plant height (cm.) at harvest.

Sprays No.	I A A concentrations (ppm)			Average of sprays number	I A A concentrations (ppm)			Average of sprays number
	0	20	40		0	20	40	
	a). 1982/83 season				b). 1983/84 season			
1	46.3	45.2	50.4	47.3	73.3	69.6	75.6	72.8
2	45.0	42.5	45.1	44.2	67.3	77.4	69.7	71.5
3	48.4	43.1	47.9	46.5	73.9	64.4	63.5	67.3
4	47.1	43.8	40.1	43.6	69.7	68.	54.6	64.1
Average of IAA	46.7	43.6	45.9		71.08	69.8	65.9	
L.S.D. at 5% for IAA =			N.S.				N.S.	
L.S.D. at 5% for sprays No. =			N.S.				N.S.	
L.S.D. at 5% for Interaction=			N.S.				N.S.	

Table (45): Effect of spraying repetation and GA_3 on plant height (cm.) at harvest.

Sprays No.	G A_3 concentrations (ppm)			Average of sprays number	G A_3 concentrations (ppm)			Average of sprays number
	0	100	200		0	100	200	
	a). 1982/83 season				b). 1983/84 season			
1	46.3	48.6	49.2	48.06	73.3	70.4	69.3	71.0
2	45.0	47.7	51.9	48.2	67.3	71.0	70.7	69.7
3	48.4	45.6	52.2	48.6	73.9	71.2	75.0	73.4
4	47.1	51.5	57.1	51.9	69.7	71.7	74.0	71.8
Average of GA_3	46.7	48.3	52.6		71.08	71.1	72.2	
L.S.D. at 5% for G A_3 =			3.32				N.S.	
L.S.D. at 5% for sprays No.=			N.S.				N.S.	
L.S.D. at 5% for Interaction=			N.S.				N.S.	

On the other hand, in the second season, spraying plants four times by IAA significantly increased the dry weight per palnt compared with three times (Table 43). It could be concluded that the effect of number of spraying with IAA on dry weight/plant showed no clear trend.

The effect of IAA - rates showed significant effect on the dry weight/plant in the two successive seasons (Tables 42 & 43). Dry matter content of plant decreased by IAA first rate (20 ppm). However, increasing applied IAA up to the higher rate (40 ppm) increased the dry weight of palnt as compared with the lower concentrations of IAA. It could be concluded that the second rate of IAA was more effective in this respect than the first one.

The effect of interaction between IAA rates and number of spraying showed seasonal variation on dry weight/plant (Tables 42 and 43). In the first season, all differences failed to reach the significant level at 5% . While, spraying plants by IAA with 40 ppm once time produced higher dry weight/plant.

The results in Tables (42 & 43) indicate clearly that GA_3 application showed significant effects on dry weight/plant in the two successive seasons. Dry weight/plant significantly increased by foliar application of GA_3 (200 ppm). The effect of GA_3 might be attributed to the increase in the vegetative growth of fenugreek plants.

Data illustrated in Table (43) show that number of spraying of GA_3 had significant effect on the dry weight/plant only in the second season. In this season the dry matter significantly decreased with increasing the spraying number of GA_3.

The interaction effect was significant in the second season only (Table 43). Spraying with 100 ppm GA_3 in the two times, i.e., 30 and 45 days from sowing produced higher dry weight/plant.

3. Number of branches/plant :

Data presented in Table (46) show that the effect of IAA and GA_3 concentration as well as spraying number and its interactions had no significant effect on the number of branches/plant. on the other hand, increasing concentration of IAA as well as GA_3 up to the higher rate significantly increased the number of branches/plant in the 1983/84 season.

Similar trend was observed with the effect of spraying number on the number of branches/plant. Increasing the spraying number to 3 times with IAA and 4 times with GA_3 significantly increased the number of branches/plant in the second season.

The effect of the interaction was significant on the number of branches/plant in the second season only. Spraying

Table (46): Effect of spraying repetation and IAA on number of branches/plant at harvest.

Sprays No.	I A A concentrations (ppm) 0	20	40	Average of sprays number	I A A concentrations (ppm) 0	20	40	Average of sprays number
	a). 1982/83 season				b). 1983/84 season			
1	2.66	2.56	2.90	2.71	2.80	2.93	2.73	2.82
2	2.46	2.36	2.73	2.52	2.93	3.16	2.93	3.01
3	2.73	2.63	2.66	2.67	3.03	3.06	2.93	3.01
4	2.96	2.86	2.76	2.86	3.10	2.86	3.13	3.03
Average of IAA	2.70	2.60	2.76		2.96	3.00	2.93	
L.S.D. at 5% for IAA=			N.S.					N.S.
L.S.D. at 5% for sprays No.=			N.S.					0.119
L.S.D. at 5% for Interaction=			N.S.					0.207

Table (47): Effect of spraying repetation and GA_3 on number of branches/plant at harvest.

Sprays No.	G A3 concentrations (ppm) 0	100	200	Average of sprays number	G A3 concentrations (ppm) 0	100	200	Average of sprays number
	a). 1982/83 season				b). 1983/84 season			
1	2.66	2.73	3.10	2.83	2.80	2.96	2.93	2.90
2	2.46	2.70	2.76	2.64	2.93	2.93	3.00	2.95
3	2.73	2.83	3.06	2.87	3.03	2.96	3.86	3.28
4	2.96	2.83	2.96	2.92	3.10	3.63	4.00	3.57
Average of GA_3	2.70	2.77	2.97		2.96	3.12	3.45	
L.S.D. at 5% for GA_3 =			N.S.					0.103
L.S.D. at 5% for sprays No =			N.S.					0.119
L.S.D. at 5% for Interaction =			N.S.					0.207

plants with higher concentration of IAA and GA_3 four times produced higher number of branches/plant in 1983/84 season.

4. Number of pods/plant :

Effect of spraying number with GA_3 or IAA on the number of pods/plant showed seasonal variations. In 1982/83, IAA or GA_3 did not show significant effect on number of pods/palnt. On the other hand, spraying with IAA or GA_3 showed significant effect on number of pods/plant in the second season. Increasing concentration of IAA significantly decreased the number of pods/plant. While, the number of pods/plant significantly increased with increasing the GA_3 rate up to 200 ppm. as shown in Table (42).

In respect the effect of spraying number on the number of pods/plant, results show that number of pods/plant increased with increasing the number of spraying with IAA or GA_3 in the second season. (Table 43).

The interaction showed significant effect on the number of pods/palnt in the 1983/84 season. Spraying plants with 40 ppm IAA or 200 ppm GA_3 once or three times produced higher number of pods/plant, respectively.

5. Weight of 100 - seed :

Results in Table (48) show that in both seasons, application of IAA had no significant effect on 100-seed weight. This result indicates that there was no relevance between the concentration of IAA and the weight of 100 seeds.

Number of spraying with IAA showed seasonal variation on 100 seeds weight (Table 48). In 1982/83 season, number of spraying had significant effect on weight of 100-seed. The seeds weight significantly decreased by treating plants more than once time with IAA. On the other hand, all differences in 100-seed weight failed to reach the significant level in the second season (Table 48).

The effect of the interaction between number of spraying and concentration of IAA was significant in the first season only. Highest average of 100-seed weight was obtained by spraying 20 ppm IAA once time or control treatment (Table 48).

Data presented in Table (49) show that concentrations of GA_3 had significant effect on the weight of 100 seed in the 1982/83 season only. Increasing rate of GA_3 up to 100 ppm significantly increased the 100-seed weight compared with the control treatment.

Table (48): Effect of the application of IAA concentrations and spraying numbers on 100-seeds weight.

Sprays NO.	I A A concentrations (ppm) 0	20	40	Average of sprays number	I A A concentrations (ppm) 0	20	40	Average of sprays number
	a). 1982/83 season				b). 1983/84 season			
1	1.97	1.92	1.89	1.93	1.77	1.84	1.68	1.76
2	1.91	1.82	1.91	1.88	1.91	1.77	1.76	1.81
3	1.67	1.73	1.80	1.73	1.84	1.64	1.75	1.74
4	1.61	1.82	1.61	1.68	1.85	1.69	1.98	1.84
Average of IAA	1.79	1.82	1.80		1.84	1.74	1.79	
L.S.D. at 5% for I A A =			N.S.				N.S.	
L.S.D. at 5% for sprays No. =			0.059				N.S.	
L.S.D. at 5% for Interaction =			0.103				N.S.	

Table (49): Effect of the application of GA_3 concentrations and spraying numbers on 100-seeds weight.

Sprays No.	A_3 concentrations (ppm) 0	100	200	Average of sprays number	G A_3 concentrations (ppm) 0	100	200	Average of sprays number
	a). 1982/83 season				b). 1983/84 season			
1	1.97	2.03	1.74	1.91	1.77	1.78	1.85	1.79
2	1.91	1.89	1.84	1.88	1.91	1.74	2.23	1.96
3	1.67	1.81	1.87	1.79	1.84	1.90	1.72	1.82
4	1.61	1.77	1.92	1.77	1.85	1.91	1.92	1.89
Average of G A_3	1.79	1.88	1.84		1.84	1.83	1.93	
L.S.D. AT 5% for G A_3 =			0.062				N.S.	
L.S.D. at 5% for sprays No. =			0.071				N.S.	
L.S.D. at 5% for Interaction =			0.124				N.S.	

Meanwhile, the number of spraying did not follow the same trend in the two successive seasons. Whereas, significantly decrease has been obtained in the first growing season and opposite trend was noticed in 1983/84 season as well as it was insignificant (Table 49).

Concerning the interaction between GA_3 concentration and the replication of spraying number, there were a differences reached the significant level in the first growing season only. Whereas, the concentration of 100 ppm GA_3 and sprayed once time increased the weight of 100 seed (Table 49).

6. Weight of seeds/plant :

Data in Table (50) show that in both season, concentration of IAA had no significant effect on the seed yield/ plant.

Spraying number of IAA showed significant effect on the weight of seeds/plant in the first growing season only. Weight of seeds/plant significantly increased with increasing number of spraying up to four times.

In 1982/83 season, weight of seeds/plant significantly influenced by the interaction between concentration of IAA and spraying numbers. Higher concentrations of IAA (200 ppm) with spraying two times produced higher seed yield/ plant compared with 40 ppm IAA with once time (Table 50).

Table (50): Effect of spraying repetation and IAA concentrations on seed yield/plant (gm.) at harvest.

Sprays No.	I A A concentrations (ppm) 0	20	40	Average of sprays number	I A A concentrations (ppm) 0	20	40	Average of sprays number
	a). 1982/83 season				b). 1983/84			
1	6.13	6.16	5.10	5.80	8.70	8.76	8.83	8.76
2	6.13	6.03	6.50	6.22	8.80	8.70	8.60	8.70
3	6.10	6.00	6.03	6.04	9.06	8.83	8.70	8.86
4	6.60	6.33	6.30	6.37	8.76	8.66	8.50	8.64
Average of IAA	6.24	6.13	5.95		8.83	8.74	8.65	
L.S.D. at 5% for I A A =			N.S				N.S.	
L.S.D. at 5% for sprays No.=			0.334				N.S.	
L.S.D. at 5% for Interaction =			0.595				N.S.	

Table (51): Effect of spraying repetation and GA_3 concentrations on seed yield/plant (gm.) at harvest.

Sprays No.	G A_3 concentrations (ppm) 0	100	200	Average of sprays number	G A_3 concentrations (ppm) 0	100	200	Average of sprays number
	a). 1982/83 season				b). 1983/84 season			
1	6.13	6.33	6.60	6.35	8.70	8.80	9.50	9.00
2	6.13	6.36	6.53	6.34	8.80	8.50	9.53	8.94
3	6.10	6.20	6.30	6.20	9.06	9.06	8.40	8.90
4	6.60	6.73	6.93	6.75	8.76	9.40	8.83	9.00
Average of GA_3	6.24	6.40	6.59		8.83	8.98	9.06	
L.S.D. at 5% for G A $_3$ =			N.S.				N.S.	
L.S.D. at 5% for sprays No.=			N.S.				N.S.	
L.S.D. at 5% for Interaction =			N.S.				N.S.	

Results in Table (51) indicate clearly that concentration of GA_3 and spraying number as well as the interaction showed no significant effect on the weight of seeds/plant in the both seasons.

7. Seed yield/faddan :

The effect of spraying replicating using IAA or GA_3 on seed yield/fad. during the 1982/83 and 1983/84 seasons are presented in Tables (52 and 53).

Concentration of IAA had no significant effect on the yield of seeds/fad. This was true for the two growing seasons (Table 52).

Spraying plants twice with IAA led to insignificantly decrease in seed yield/fad. less than plants sprayed once time, three and four times in the two successive seasons.

The effect of GA_3 concentration had no significant effect on seed yield/fad. in the both growing seasons(Table 53).

With regard to replicating spray of GA_3 three times significantly increased the seed yield/fad. more than the other treatments in the second growing season only (Table53).

Data presented in Tables (52 and 53) indicate that the effect of the interactions on the yield of seeds/fad. were not significant in the two successive seasons.

Table (52): Effect of sprays number of IAA concentrations on seed yield/faddan (Kg.) at harvest.

Sprays No.	I A A concentrations (ppm) 0	20	40	Average of sprays number	I A A concentrations (ppm) 0	20	40	Average of sprays number
	a). 1982/83 season				b). 1983/84 season			
1	315.2	322.2	329.6	322.3	742.7	615.4	382.4	580.2
2	304.3	344.8	225.3	291.4	402.2	533.3	549.0	494.8
3	319.0	319.9	281.7	309.9	664.1	561.9	758.1	661.4
4	286.9	351.9	271.6	303.4	644.1	692.1	531.5	622.6
Average of IAA	306.3	334.7	277.0		613.2	600.6	555.2	
L.S.D. at 5% for I A A =		N.S.				N.S.		
L.S.D. at 5% for sprays No.=		N.S.				N.S.		
L.S.D. at 5% for Interaction =		N.S.				N.S.		

Table (53): Effect of sprays number of GA_3 concentrations on seed yield/faddan (Kg.) at harvest.

Sprays No.	G A_3 concentrations (ppm) 0	100	200	Average of sprays number	G A_3 concentrations (ppm) 0	100	200	Average of sprays number
	a). 1982/83 season				b). 1983/84 season			
1	315.2	200.8	327.8	281.3	742.7	681.2	631.5	685.1
2	304.3	275.8	252.2	277.4	424.1	711.3	765.2	633.5
3	319.1	323.7	405.0	349.2	664.1	491.1	548.1	567.7
4	286.9	271.6	196.9	251.8	688.0	794.5	573.8	685.4
Average of GA_3	306.3	268.0	295.4		629.7	669.5	629.6	
L.S.D. at 5% for G A_3 =		N.S.				N.S.		
L.S.D. at 5% for sprays No.=		53.3				N.S.		
L.S.D. at 5% for Interaction =		N.S.				N.S.		

8. Biological yield per faddan :

Results in Tables (54 and 55) showed no significant effects of IAA, GA_3 and spraying number on biological yield/ fad. in 1982/83 and 1983/84 seasons.

II. Chemical analysis for seeds :

1. Oil content :

All factors under this study showed no significant effect on percentage of oil in fenugreek seeds. Expect the effect of spraying number of GA_3 had significant effect on this character in the second season only (Table 56 and 57). Increasing number of spraying with GA_3 decreased significantly the seed yield/fad. Spraying plants once time led to significantly increased in seed yield/fad. compared with the other treatments (Table 57).

2. Mineral elements :

a). N - content:

Data presented in Tables (58a and 58b) indicate that concentration of IAA had significant effect on N-content in seeds in the second season only. Nitrogen content of seeds significantly increased by applying 20 ppm IAA. On the other hand, GA_3 concentration as well as number of spraying of IAA or GA_3 showed no significant effect on N-content.

Table (54): Effect of sprays numbers and IAA concentrations on biological yield/faddan (Kg.) at harvest during 1982/83 and 1983/84 seasons/

Sprays No.	I A A concentrations (ppm) 0	20	40	Average of sprays number	I A A concentrations (ppm) 0	20	40	Average of sprays number
	a). 1982/83 season				b). 1983/84 season			
1	410.0	420.0	423.3	417.7	836.6	316.6	483.3	545.5
2	400.0	443.3	333.3	392.2	526.6	630.0	646.6	601.1
3	420.0	423.3	386.6	410.0	766.6	656.6	860.0	761.1
4	386.0	443.3	360.0	396.6	773.3	783.3	633.3	730.0
Average of IAA	404.1	432.5	375.8		725.8	596.6	655.8	
L.S.D. at 5% for I A A =			N.S.				N.S.	
L.S.D. at 5% for sprays No.=			N.S.				N.S.	
L.S.D. at 5% for Interaction =			N.S.				N.S.	

Table (55): Effect of sprays numbers and GA_3 concentrations on biological yield/faddan (Kg.) at harvest during 1982/83 and 1983/84 seasons.

Sprays No.	G A_3 concentrations (ppm) 0	100	200	Average of sprays number	G A_3 concentrations (ppm) 0	100	200	Average of sprays number
	a). 1982/83 season				b). 1983/84 season			
1	410.0	310.0	433.3	384.4	836.6	786.6	736.6	786.6
2	400.0	396.6	363.3	386.6	526.6	790.0	863.3	726.6
3	420.0	433.3	510.0	454.4	766.6	663.3	636.6	688.8
4	386.0	376.6	303.3	355.5	773.3	900.0	680.0	784.4
Average of GA_3 =	404.1	379.1	402.5		725.8	785.0	729.1	
L.S.D. at 5% for G A_3			N.S.				N.S.	
L.S.D. at 5% for sprays No.=			N.S.				N.S.	
L.S.D. at 5% for Interaction =			N.S.				N.S.	

Table (56): Effect of sprays numbers of IAA concentrations on oil percentage during the growinghseasons of 1982/83 and 1983/84.

Sprays No.	I A A concentrations (ppm)			Average of sprays number	I A A concentrations (ppm)			Average of sprays number
	0	20	40		0	20	40	
	a). 1982/83 season				b). 1983/84 season			
1	8.62	8.12	8.13	8.29	8.66	9.13	7.88	8.56
2	7.91	8.80	8.16	8.29	7.79	8.52	7.97	8.09
3	8.38	8.66	8.27	8.44	8.33	8.28	8.40	8.34
4	8.01	8.40	9.19	8.54	8.16	8.24	8.35	8.25
Average of I A A	8.23	8.49	8.44		8.24	8.54	8.15	
L.S.D. at 5% for I A A =			N.S.				N.S.	
L.S.D. at 5% for sprays No.=			N.S.				N.S.	
L.S.D. at 5% for Interaction =			N.S.				N.S.	

Table (57): Effect of sprays numbers of GA_3 concentrations on oil percentage during the growing seasons of 1982/83 and 1983/84.

Sprays No.	G A 3 concentrations (ppm)			Average of sprays number	G A 3 concentrations (ppm)			Average of sprays number
	0	100	200		0	100	200	
	a). 1982/83 season				b). 1983/84 season			
1	8.62	8.94	8.59	8.72	8.66	9.33	8.26	8.75
2	7.91	8.63	8.50	8.35	7.79	8.39	8.46	8.21
3	8.38	8.25	8.33	8.32	8.33	8.08	8.35	8.25
4	8.01	8.29	8.65	8.32	8.16	7.79	8.78	8.24
Average of GA_3	8.23	8.53	8.52		8.24	8.39	8.46	
L.S.D. at 5% for GA_3			N.S.				N.S.	
L.S.D. at 5% for sprays No.=			0.322				N.S.	
L.S.D. at 5% for Interaction =			N.S.				N.S.	

Table (58-a): Effect sprays number of IAA on mineral elements in seeds during 1982/83 and 1983/84 growing seasons.

a) 1982/83 season

I A A concentrations (ppm)	Minerals	Sprays Number				Average of I A A
		1	2	3	4	
0	Nitrogen	8.0	6.4	6.6	6.1	6.75
	Sodium	4.9	6.4	5.4	8.2	6.20
	Potassium	28.7	29.3	28.8	23.2	27.5
	Phosphorus	0.21	0.23	0.18	0.15	0.19
20	Nitrogen	7.0	6.3	5.7	6.3	6.3
	Sodium	5.6	5.9	6.8	6.5	6.2
	Potassium	29.1	29.5	32.1	28.9	29.9
	Phosphorus	0.36	0.37	0.11	0.08	0.23
40	Nitrogen	6.6	6.4	6.9	6.9	6.7
	Sodium	8.2	5.8	6.7	5.7	6.6
	Potassium	29.9	30.3	27.8	28.4	29.1
	Phosphorus	0.29	0.29	0.24	0.21	0.23
Average of sprays number	Nitrogen	7.2	6.3	6.4	6.4	6.6
	Sodium	6.2	6.0	6.3	6.8	6.3
	Potassium	29.3	29.7	29.6	26.8	28.8
	Phosphorus	0.25	0.29	0.18	0.15	0.22

L. S. D. at 5% for :	N	Na	K	P
I A A =	N.S.	N.S.	N.S.	N.S.
Sprays No.=	N.S.	N.S.	N.S.	N.S.
Interaction =	N.S.	N.S.	N.S.	N.S.

Table (58_b): Effect sprays number of IAA on mineral elements in seeds during 1982/83 and 1983/84 growing seasons.

a) 1983/84 season

IAA concentrations (ppm)	Minerals	Sprays Number 1	2	3	4	Average of IAA
0	Nitrogen	6.2	5.9	6.6	7.3	6.5
	Sodium	6.7	8.4	10.9	7.1	8.3
	Potassium	28.8	27.9	31.9	26.4	28.8
	Phosphorus	0.22	0.174	0.21	0.21	0.19
20	Nitrogen	6.6	7.5	7.7	7.8	7.4
	Sodium	7.9	7.7	7.8	9.2	8.1
	Potassium	28.2	29.8	29.5	29.2	29.2
	Phosphorus	0.33	0.15	0.26	0.26	0.25
40	Nitrogen	6.5	6.5	07.0	6.8	6.7
	Sodium	13.4	12.3	11.7	14.8	13.0
	Potassium	30.3	28.5	29.4	29.5	29.4
	Phosphorus	0.25	0.32	0.09	0.19	0.20
Average of sprays number	Nitrogen	6.4	6.6	7.1	7.3	6.9
	Sodium	9.3	9.5	10.1	10.3	9.8
	Potassium	29.1	28.7	30.2	28.4	29.1
	Phosphorus	0.25	0.21	0.19	0.22	0.22

L. S. D. at 5% for :	N	Na	K	P
IAA =	0.62	3.72	1.04	N.S.
Sprays No.=	N.S.	N.S.	N.S.	N.S.
Interaction =	N.S.	N.S.	N.S.	0.13

Table (59_a): Effect sprays number of GA_3 on mineral elements in seeds during 1982/83 and 1983/84 growing seasons.

a) 1982/83 season

GA_3 concentrations (ppm)	Minerals	Sprays Number				Average of GA_3
		1	2	3	4	
0	Nitrogen	8.0	6.4	6.6	6.0	6.7
	Sodium	4.9	6.4	5.4	8.4	6.3
	Potassium	28.7	29.3	28.8	23.2	27.5
	Phosphorus	0.21	0.23	0.18	0.15	0.19
100	Nitrogen	8.0	7.1	7.6	9.0	7.9
	Sodium	7.9	4.7	7.4	6.3	6.6
	Potassium	32.5	31.1	31.1	22.4	28.9
	Phosphorus	0.18	0.23	0.15	0.22	0.19
200	Nitrogen	6.7	7.3	6.0	8.5	7.1
	Sodium	5.9	7.0	7.0	7.3	6.8
	Potassium	29.2	28.3	27.7	28.9	28.5
	Phosphorus	0.24	0.21	0.21	0.19	0.22
Average of sprays number	Nitrogen	7.6	6.9	6.7	7.8	7.3
	Sodium	6.3	6.0	6.6	7.3	6.6
	Potassium	28.8	29.5	29.2	24.9	28.3
	Phosphorus	0.21	0.22	0.18	0.19	0.20

L. S. D. at 5% for :	N	Na	K	P
GA_3 =	N.S.	N.S.	N.S.	N.S.
Sprays No.=	N.S.	N.S.	N.S.	N.S.
Interaction =	N.S.	N.S.	N.S.	N.S.

Table (59_b): Effect sprays number of GA_3 on mineral elements in seeds during 1982/83 and 1983/84 growing seasons.

a) 1983/84 season

GA_3 concentrations (ppm)	Minerals	Sprays Number				Average of GA_3
		1	2	3	4	
0	Nitrogen	6.2	5.9	6.6	7.3	6.5
	Sodium	6.7	8.4	10.9	7.1	8.3
	Potassium	28.8	27.9	31.9	26.4	28.8
	Phosphorus	0.17	0.17	0.21	0.21	0.19
100	Nitrogen	6.3	7.3	7.1	6.45	6.8
	Sodium	6.8	9.8	9.6	6.3	8.1
	Potassium	31.1	31.0	30.9	29.9	30.7
	Phosphorus	0.19	0.16	0.15	0.24	0.19
200	Nitrogen	6.6	6.5	6.8	7.1	6.7
	Sodium	9.2	9.7	12.5	5.9	9.3
	Potassium	30.9	28.5	28.5	29.4	29.3
	Phosphorus	0.18	0.09	0.19	0.20	0.17
Average of sprays number	Nitrogen	6.4	6.6	6.8	6.9	6.7
	Sodium	7.6	9.3	10.9	6.4	8.6
	Potassium	30.3	29.1	30.4	28.6	29.6
	Phosphorus	0.18	0.14	0.18	0.22	0.18

L. S. D. at 5% for :	N	Na	K	P
GA_3 =	N.S.	N.S.	1.40	N.S.
Sprays No.=	N.S.	N.S.	N.S.	N.S.
Interaction =	N.S.	N.S.	N.S.	N.S.

b). Na - content :

The effect of IAA concentration on Na-content of seeds showed seasonal variations (Tables 58a and 58b). In 1983/84 season, higher rate of IAA (40 ppm) produced higher Na-content in seeds. On the other side, GA_3 concentration and spraying number did not show significant effect on Na-content.

c). K - content :

Data presented in Tables (58 and 59) show that the concentrations of IAA or GA_3 had significant effect on K-content of seeds. Rate of IAA (40 ppm) and 100 ppm GA_3 produced higher k-content in seeds.

d). P - content :

Results in Tables (58 and 59) indicate that P-content of fenugreek seeds not affected by all factors under this study in the two successive seasons.