# IV. RESULTS AND DISCUSSION

## IV. 1. First Experiment :

Effect of different rates of nitrogen and phosphorus fertilizers, on vegetative growth, herb and seed yield and quality as well as chemical constituents of herb and seeds of coriander plants.

### IV.1.1. Vegetative growth of plants :

Data reported in Table (1) show the effect of both nitrogen and phosphorus fertilizers applied at different rates on the plant height, plant fresh weight and dry weight percentage of coriander plants. Such data show that increasing nitrogen fertilizer rate from 0 up to 60 kg N/feddan significantly increased all morphological characters studied. Obtained data are going in the same trend at both successive seasons of (1985/86 and 1986/87). Obtained results are in agreement with those of many investigators working on the effect of nitrogen fertilizer application on vegetative growth of different crops such as Hornok (1979), and Abou-Dahab et al. (1984) working on coriander, Hawthorn (1952) on carrot and El-Mazny and Badran (1984) on cumin, regarding the effect on plant height. Moreover, similar results were reported by El-Gangaihi (1964), Sharaf (1965) and El-Hamidi et al. (1968) all working on

Table (1): Effect of different rates of nitrogen and phosphorus fertilizers on vegetative growth of coriander plants.

| Fertilizers | | First season 1985/86 | | | Second season 1986/87 | | |
|---|---|---|---|---|---|---|---|
| N kg/fed. | $P_2O_5$ kg/fed. | Plant height (cm) | Fresh weight (gm/plant) | Dry weight % | Plant height (cm) | Fresh weight (gm/plant) | Dry weight % |
| 0 | 0 | 32.0 | 94.1 | 8.9 | 38.0 | 108.1 | 9.7 |
| 20 | | 35.3 | 110.3 | 9.5 | 40.0 | 124.4 | 10.4 |
| 40 | | 37.8 | 125.5 | 10.3 | 42.8 | 140.3 | 11.2 |
| 60 | | 40.3 | 136.4 | 10.7 | 46.0 | 151.8 | 11.4 |
| 0 | 16 | 33.3 | 98.1 | 9.3 | 39.5 | 112.7 | 10.1 |
| 20 | | 38.0 | 118.1 | 10.3 | 43.5 | 133.3 | 11.0 |
| 40 | | 43.0 | 136.8 | 11.2 | 48.0 | 152.7 | 12.0 |
| 60 | | 48.0 | 151.3 | 12.0 | 53.0 | 169.5 | 12.8 |
| 0 | 32 | 36.0 | 104.0 | 9.5 | 41.1 | 117.9 | 10.4 |
| 20 | | 40.0 | 122.9 | 10.4 | 45.0 | 138.0 | 11.1 |
| 40 | | 44.5 | 142.8 | 11.3 | 49.5 | 157.5 | 12.2 |
| 60 | | 50.3 | 160.1 | 12.1 | 54.5 | 175.0 | 12.9 |
| 0 | 48 | 37.0 | 106.5 | 9.5 | 42.0 | 119.8 | 10.5 |
| 20 | | 41.0 | 125.8 | 10.4 | 46.0 | 139.4 | 11.1 |
| 40 | | 45.0 | 145.5 | 11.4 | 50.0 | 158.9 | 12.3 |
| 60 | | 50.3 | 160.3 | 12.0 | 54.5 | 176.1 | 12.7 |
| L.S.D. at 1 % | | 3.1 | 0.9 | 0.3 | 1.9 | 1.9 | 0.4 |
| 0 | | 34.8 | 100.6 | 9.3 | 40.2 | 114.6 | 10.2 |
| 20 | | 38.6 | 119.3 | 10.1 | 43.6 | 133.8 | 10.9 |
| 40 | | 42.6 | 137.6 | 11.0 | 47.5 | 152.4 | 11.9 |
| 60 | | 47.2 | 152.0 | 11.7 | 52.0 | 168.1 | 12.4 |
| L.S.D. at 1 % | | 1.6 | 0.5 | 0.2 | 0.9 | 0.9 | 0.2 |
| | 0 | 36.6 | 116.6 | 9.8 | 41.7 | 131.2 | 10.7 |
| | 16 | 40.6 | 126.1 | 10.2 | 46.0 | 142.0 | 11.5 |
| | 32 | 42.7 | 132.4 | 10.8 | 46.6 | 147.1 | 11.7 |
| | 48 | 43.7 | 134.5 | 10.8 | 48.1 | 148.6 | 11.7 |
| L.S.D. at 1 % | | 1.6 | 0.5 | 0.2 | 0.9 | 0.9 | 0.2 |

geranium, Othman (1972) on fennel and Feigin et al. (1976) on celery, respecting fresh weight of plant. The findings of Abou-Dahab et al. (1984) on coriander, Othman (1972) on fennel, Feigin et al. (1976) on Celery and Singh et al.(1983) on mint are also in confirmity with obtained results of this work with regard to dry weight of herb.

According to the effect of phosphorus fertilizer, data presented in Table (1) show that the different measurements of plant growth were significantly increased with increasing the rate of phosphorus fertilizer from 0 up to 48 kg $P_2O_5$/ feddan. Such enhancing effect of P fertilizer was observed at both seasons of this experimental work. However, increasing phosphorus fertilizer more than 32 kg $P_2O_5$/feddan did not show superiority in case of dry matter percentage. Results at the same table indicate also that the application of the highest used levels of phosphorus (32 or 48 kg $P_2O_5$/feddan) resulted in the highest plant growth. These findings are going in harmony with those reported by Zal.Tafar (1975), Abou-Dahab et al. (1984) working on coriander, Singh and Singh (1970) and Singh (1979) on mint.

With respect to the interactional effect of both nitrogen and phosphorus fertilizers rates,the same data shown in Table (1) indicate that application of 60 kg N combined with 48 or 32 kg $P_2O_5$/feddan resulted in the highest values of

plant height and fresh weight as well as dry matter percentage of coriander plants. It is also evident that results of both seasons of this work are of the same trend. obtained results were supported by those of many investigators i.e. Hornok (1979), Abou-Dahab et al. (1984) working on coriander, El-Sahhar et al. (1977) and Singh et al. (1983) on mint, and Liloyan and Manukyan (1978) on geranium.

Finally it may be concluded that it is advisable to increase the rate of nitrogen fertilizer up to 60 kg N/fed. combined with a rate of phosphorus fertilizer at 32 kg $P_2O_5$/ feddan in the fertilization program of coriander plants to obtain the highest vegetative growth.

IV.1.2. Fresh herb and seed yield :

Data presented in Table (2) and Fig. (1) show that increasing the rate of N fertilizer from 0 up to 60 kg N/ feddan significantly increased the yield of fresh herb, seed yield and seed index of coriander plants. It is clearly evident also that the highest values of herb yield (ton/ feddan), seed yield either as gm/plant or as kg/feddan and weight of 100 seeds obtained from plants received the highest rates of N (60 kg N/feddan). Moreover, it is obvious also that the obtained data are going in the same trend at the two successive seasons of this work. Such results are in agreement with those reported by Abou-Dahab et al. (1984)

Table (2): Effect of different rates of N and P-fertilizers on fresh herb and seed yield and quality of coriander plants.

| Fertilizers | | First season 1985/86 | | | | Second season 1986/87 | | | |
|---|---|---|---|---|---|---|---|---|---|
| N | $P_2O_5$ | Fresh herb | Seed yield | | Wt.of 100 seeds | Fresh herb | Seed yield | | Wt. of 100 seeds |
| kg/fed. | kg/fed. | (ton/ fed.) | (gm/ pl.) | (kg/ fed.) | (gm) | (ton/ fed.) | (gm/ pl.) | (kg/ fed.) | (gm) |
| 0 | | 12.041 | 4.6 | 588 | 1.30 | 13.844 | 4.9 | 630 | 1.28 |
| 20 | 0 | 14.120 | 6.1 | 780 | 1.36 | 15.920 | 6.5 | 840 | 1.35 |
| 40 | | 16.064 | 7.4 | 944 | 1.36 | 17.968 | 7.9 | 1008 | 1.36 |
| 60 | | 17.456 | 8.3 | 1056 | 1.38 | 19.429 | 8.8 | 1128 | 1.36 |
| 0 | | 12.552 | 4.9 | 636 | 1.34 | 14.416 | 5.5 | 696 | 1.32 |
| 20 | 16 | 15.120 | 6.6 | 844 | 1.38 | 17.056 | 7.2 | 920 | 1.36 |
| 40 | | 17.504 | 8.3 | 1052 | 1.36 | 19.536 | 8.9 | 1136 | 1.35 |
| 60 | | 19.367 | 9.6 | 1228 | 1.38 | 21.716 | 10.4 | 1328 | 1.38 |
| 0 | | 13.305 | 5.3 | 676 | 1.34 | 15.088 | 5.8 | 744 | 1.32 |
| 20 | 32 | 15.704 | 7.0 | 925 | 1.36 | 17.664 | 7.6 | 968 | 1.36 |
| 40 | | 18.272 | 8.7 | 1112 | 1.38 | 20.160 | 9.2 | 1176 | 1.36 |
| 60 | | 20.496 | 10.0 | 1288 | 1.40 | 22.383 | 10.6 | 1358 | 1.38 |
| 0 | | 13.624 | 5.6 | 708 | 1.34 | 15.330 | 6.0 | 772 | 1.32 |
| 20 | 48 | 16.104 | 7.2 | 921 | 1.36 | 17.840 | 7.7 | 988 | 1.36 |
| 40 | | 18.624 | 8.7 | 1124 | 1.36 | 20.336 | 9.3 | 1196 | 1.38 |
| 60 | | 20.520 | 11.2 | 1295 | 1.36 | 22.544 | 10.7 | 1360 | 1.36 |
| L.S.D. at 1 % | | 0.160 | 0.3 | 39 | N.S | 0.241 | 0.2 | 29 | N.S |
| 0 | | 12.880 | 5.1 | 653 | 1.33 | 14.667 | 5.6 | 711 | 1.31 |
| 20 | | 15.262 | 6.7 | 861 | 1.37 | 17.120 | 7.3 | 929 | 1.36 |
| 40 | | 17.616 | 8.3 | 1058 | 1.37 | 19.500 | 8.8 | 1129 | 1.36 |
| 60 | | 19.460 | 9.5 | 1217 | 1.39 | 21.517 | 10.1 | 1294 | 1.37 |
| L.S.D. 1 % | | 0.080 | 0.2 | 20 | 0.02 | 0.120 | 0.1 | 14 | 0.02 |
| | 0 | 14.920 | 6.6 | 842 | 1.35 | 16.789 | 7.0 | 902 | 1.34 |
| | 16 | 16.136 | 7.4 | 940 | 1.37 | 18.181 | 8.0 | 1020 | 1.35 |
| | 32 | 16.944 | 7.8 | 994 | 1.37 | 18.824 | 8.3 | 1062 | 1.36 |
| | 48 | 17.218 | 7.9 | 1012 | 1.36 | 19.012 | 8.4 | 1079 | 1.36 |
| L.S.D. 1 % | | 0.080 | 0.2 | 20 | 0.02 | 0.120 | 0.1 | 14 | 0.02 |

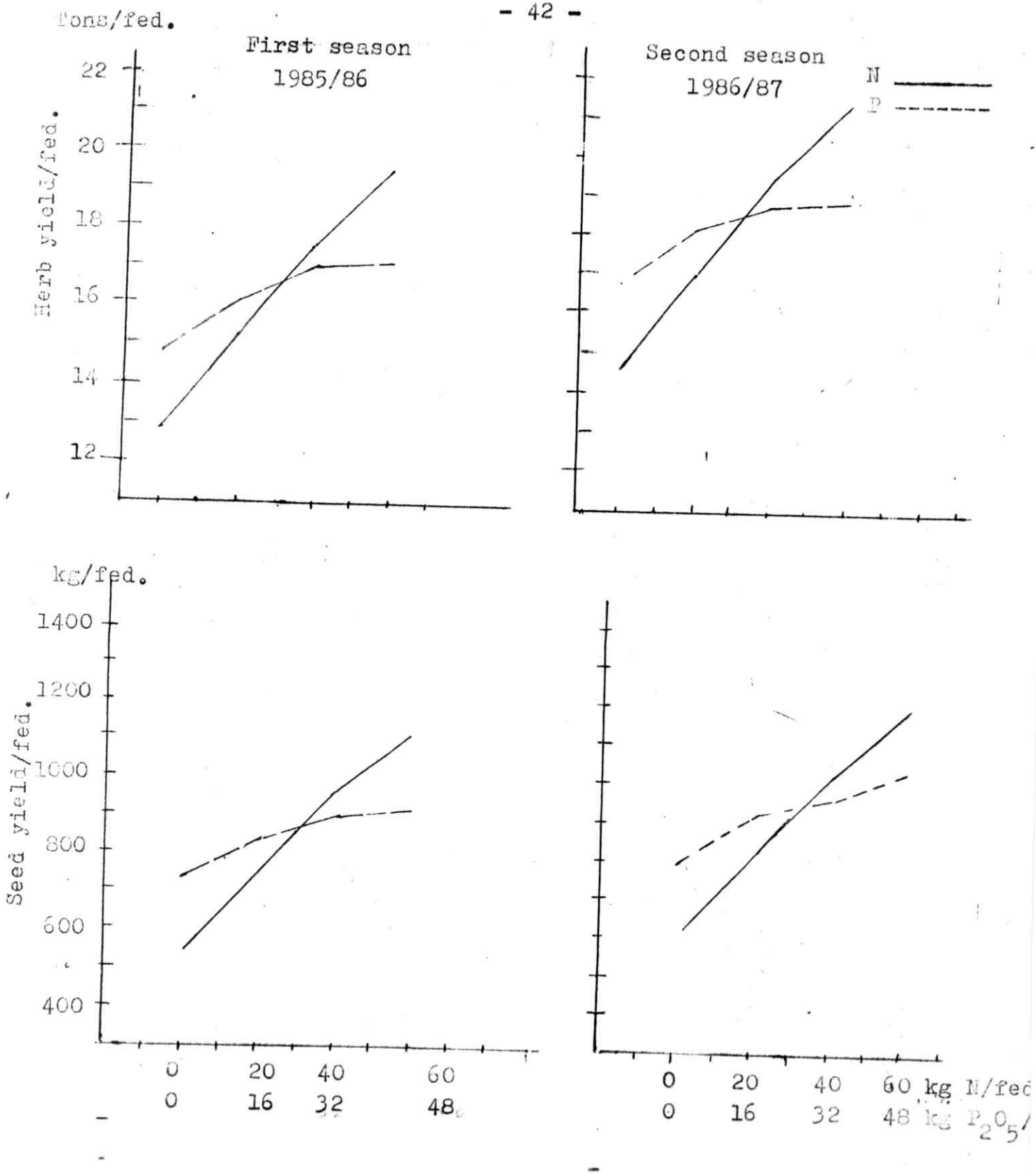


Fig. (1): Effect of different rates of N and P fertilizers on fresh herb yield (ton/fed.) and seed yield (kg/fed.) of coriander plants.

working on cariander, Mohandas and Sampath (1983) on geranium, Verma and Fernandez (1983) on mint, regarding nitrogen fertilizer effect on fresh herb yield.

With respect to the effect of N fertilizer on seed yield, different investigators i.e. El-Mansi et al. (1970), Mathur et al. (1973), El-Gamassy and El-Sayed (1977) and Abou-Dahab et al. (1984) working on coriander plants, Randahawa et al. (1981) and Gill and Samra (1986) on fennel and El-Mazny and Badran (1984) on cumin, came to similar findings of this work.

Regarding the effect of N-fertilizer on quality of seeds, Abou-El-Fadl (1969) on fennel and El-Mazny and Badran (1984) on cumin found similar results to those of this work.

Data presented in Table (2) and Fig. 1) show also that fresh herb yield (ton/feddan), seed yield expressed either as gm/plant or as kg/feddan and weight of 100 seeds were significantly increased with increasing the phosphorus fertilizer rates from 0 up to 48 kg $P_2O_5$/feddan. The highest values in this respect were obtained when coriander plants were fertilized with either 32 or 48 kg $P_2O_5$/feddan. Results are going in the same trend at both seasons of this work. In this concern Abou-Dahab et al. (1984) working on coriander, Singh and Singh (1970) and Singh (1979) both

working on Japanese mint, found that the fresh weight of foliage was considerably increased with increasing phosphorus fertilizer level.

With respect to the effect of P-fertilizer on seed yield, El-Mansi et al. (1970) and Abou-Dahab et al. (1984) both on coriander, as well as, Abdallah et al. (1978) and Randahawa et al. (1981) on fennel plants obtained similar results to those of this work where $P_2O_5$ application increased seed yield of such crops.

With regard to the combined effect of N and P-fertilizers on fresh herb and seed yield as well as weight of 100 seeds, it is evident from the data at table (2) that application of 60 kg N combined with 32 or 48 $P_2O_5$/feddan produced the highest yield of fresh herb (ton/feddan) and of seeds (gm/plant or kg/feddan). Similar results were noticed by both of Hornok (1979) and Abou-Dahab et al. (1984) who found that high level of P and moderate level of N fertilizers resulted in the highest fresh herbage yield of coriander plants. Moreover, obtained results are going in the same trend with those reported by El-Sahhar et al. (1977), and Singh et al. (1983) working on mint.

With respect to the combined effect of N and P-fertilizers on seed yield (gm/plant or kg/feddan), some investigators, i.e. Singh and Jain (1971), Pillat and Boominathan (1975), Hornok

(1979) and Abou-Dahab et al. (1984) all working on coriander, came to the same conclusion of this work, where the highest used level of both N and P fertilizers showed the highest seed yields.

Finally, it may be concluded that soil application of 60 kg N/feddan and 32 kg $P_2O_5$/feddan to the coriander plants at two portions (1 and 2 month after planting) is recommended to obtain the highest fresh herb, and seed yield, either per plant or per feddan with best seed quality.

IV.1.3. Oil content in herb and seeds of coriander plants :

Data presented in Table (3) and Fig. (2) show that increasing the rate of nitrogen fertilizer significantly increased the volatile oils content of both herb and seeds at both seasons. It is also evident that application of 60 kg N/fed. was associated with the highest values of volatile oils percentage and yield of both herb and seeds of coriander plant. Moreover, results are going in the same trend at both seasons of this work. Such favourable effect of N on oils content of herb, has been reported also by Abou-Dahab et al. (1984) working on coriander, El-Gangaihi (1964) and Mohandas and Sampath (1983) both on geranium, Latypov (1960) and Verma and Fernandez (1983) on mint. Regarding the effect of N on oil contents of seeds, El-Mansi et al. (1970), El-Gamassy and El-Sayed (1977), as well as Abou-Dahab et al. (1984)

on coriander and Abou El-Fadl (1969) on fennel found that volatile oil content of coriander seeds increased with increasing N fertilizer rate.

Concerning the effect of phosphorus fertilizer on volatile oils content of coriander plants, it is clear from data in Table (3) and Fig. (2) that application of phosphorus fertilizer significantly increased oil content of both fresh herb and seeds than the control. Moreover, it is obvious from such data that increasing rate of phosphorus fertilizer more than 32 kg $P_2O_5$/feddan was of insignificant effect in this respect. Therefore, application of 32 kg $P_2O_5$/feddan could be recommended as the most favourable rate for oil production from both herb and seeds of coriander. These results are in agreement with those obtained by El-Mansi et al. (1970) and Abou-Dahab et al. (1984) both working on coriander, Singh and Singh (1970) and Singh (1979) working on mint plants in case of oil yield of herb. Moreover, concerning the effect of P-fertilizer on volatile oil content of seeds, El-Mansi et al. (1970) and Abou-Dahab et al. (1984) both working on coriander, and Abdallah et al. (1978) on fennel obtained similar results to those of this work.

Regarding the interactional effect of N and P-fertilizers on volatile oils content and yield of coriander plants, it is evident from the same data at table (3) that application of

Table (3): Effect of different rates of Nitrogen and Phosphorus fertilizers on volatile oil contents in herb and seeds of corinder plants.

| Fertilizer | | First season 1985/86 | | | | Second season 1986/87 | | | |
|---|---|---|---|---|---|---|---|---|---|
| N kg/fed. | $P_2O_5$ kg/fed. | Herb oil % (cm/100 gm) | Herb oil yield (lit/fed) | Seed oil % (cm/100 gm) | Seed oil yield (L/fed.) | Herb oil % (cm/100 gm) | Herb oil yield (L/fed.) | Seed oil % (cm/100 gm) | Seed oil yield (L/fed. |
| 0 | | 0.007 | 0.903 | 0.25 | 1.467 | 0.009 | 1.210 | 0.28 | 1.742 |
| 20 | 0 | 0.009 | 1.059 | 0.28 | 2.181 | 0.011 | 1.794 | 0.31 | 2.602 |
| 40 | | 0.011 | 1.806 | 0.31 | 2.929 | 0.013 | 2.244 | 0.33 | 3.326 |
| 60 | | 0.013 | 2.181 | 0.33 | 3.484 | 0.015 | 2.911 | 0.35 | 3.948 |
| 0 | | 0.009 | 1.085 | 0.27 | 1.715 | 0.011 | 1.617 | 0.30 | 2.104 |
| 20 | 16 | 0.013 | 1.890 | 0.30 | 2.529 | 0.014 | 2.346 | 0.33 | 3.033 |
| 40 | | 0.015 | 2.625 | 0.33 | 3.470 | 0.018 | 3.419 | 0.35 | 3.972 |
| 60 | | 0.020 | 3.899 | 0.37 | 4.542 | 0.023 | 4.887 | 0.39 | 5.212 |
| 0 | | 0.010 | 1.331 | 0.28 | 1.892 | 0.012 | 1.888 | 0.31 | 2.305 |
| 20 | 32 | 0.013 | 1.963 | 0.31 | 2.791 | 0.015 | 2.649 | 0.34 | 3.290 |
| 40 | | 0.016 | 2.969 | 0.34 | 3.780 | 0.019 | 3.778 | 0.37 | 4.350 |
| 60 | | 0.021 | 4.356 | 0.38 | 4.873 | 0.024 | 5.315 | 0.40 | 5.432 |
| 0 | | 0.011 | 1.534 | 0.29 | 2.051 | 0.013 | 1.917 | 0.32 | 2.471 |
| 20 | 48 | 0.014 | 2.216 | 0.32 | 2.949 | 0.016 | 2.897 | 0.35 | 3.458 |
| 40 | | 0.018 | 3.260 | 0.35 | 3.936 | 0.020 | 3.568 | 0.37 | 4.423 |
| 60 | | 0.021 | 4.361 | 0.38 | 4.918 | 0.024 | 5.353 | 0.40 | 5.439 |
| L.S.D. 5 % | | | 0.629 | | 0.305 | | 0.528 | | 0.244 |
| 0 | | 0.010 | 1.213 | 0.27 | 1.781 | 0.011 | 1.658 | 0.30 | 2.152 |
| 20 | | 0.012 | 1.781 | 0.30 | 2.612 | 0.014 | 2.422 | 0.33 | 3.096 |
| 40 | | 0.015 | 2.541 | 0.33 | 3.529 | 0.017 | 3.252 | 0.36 | 4.018 |
| 60 | | 0.019 | 3.693 | 0.37 | 4.459 | 0.021 | 4.616 | 0.39 | 5.008 |
| L.S.D. 5 % | | | 0.313 | | 0.153 | | 0.426 | | 0.122 |
| | 0 | 0.010 | 1.488 | 0.29 | 2.515 | 0.012 | 2.040 | 0.32 | 2.901 |
| | 16 | 0.014 | 2.368 | 0.32 | 3.064 | 0.016 | 3.067 | 0.34 | 3.581 |
| | 32 | 0.015 | 2.655 | 0.33 | 3.339 | 0.018 | 3.408 | 0.36 | 3.844 |
| | 48 | 0.016 | 2.843 | 0.34 | 3.464 | 0.018 | 3.427 | 0.36 | 3.948 |
| L.S.D. 5 % | | | 0.313 | | 0.153 | | 0.264 | | 0.122 |

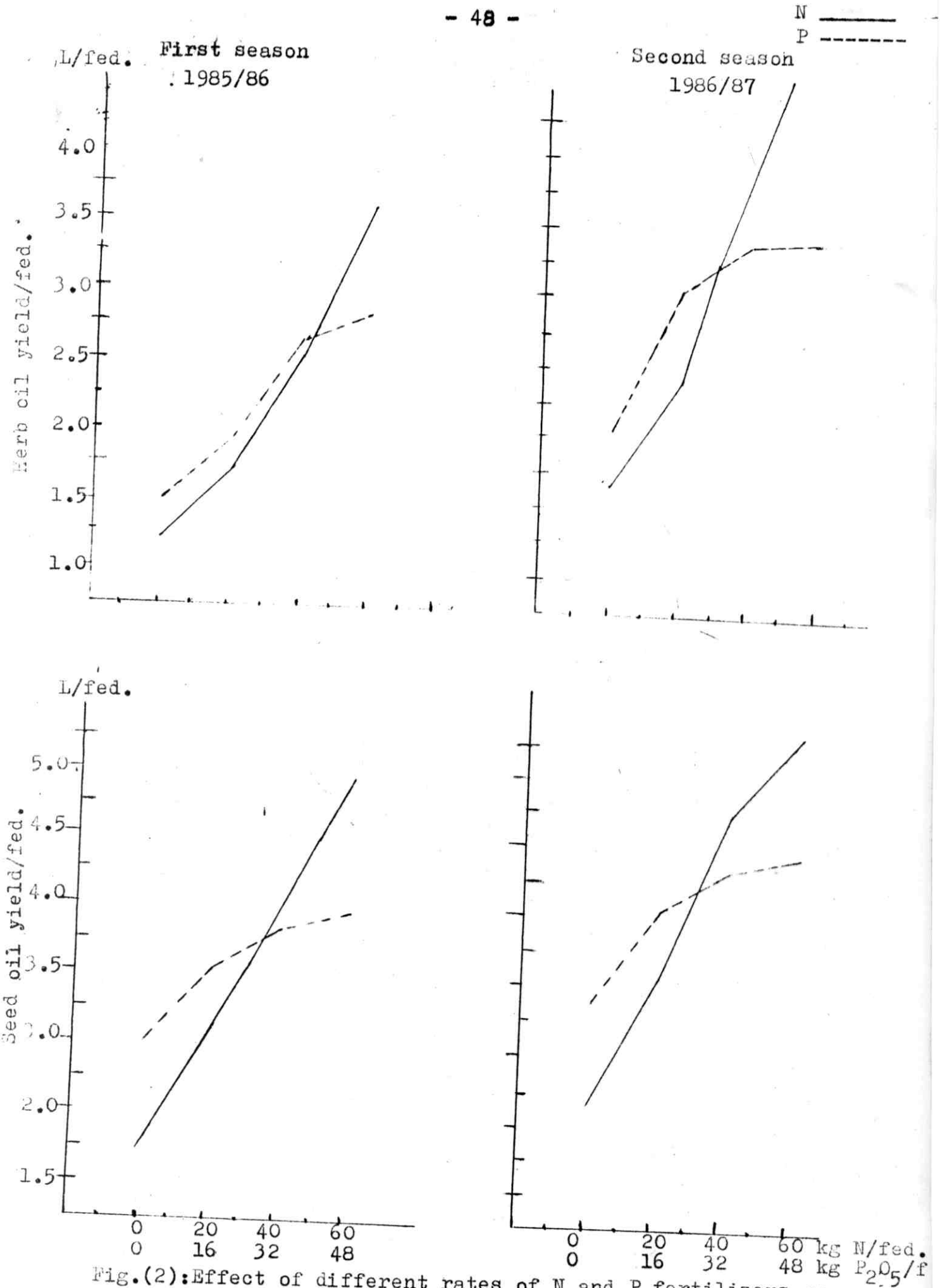


Fig.(2):Effect of different rates of N and P fertilizers on volatile oil yield of herb and seeds (L/fed.) of coriander plants.

60 kg N combined with 32 kg $P_2O_5$/feddan gave the highest volatile oil percentage and yield for both herb and seeds compared to the other used treatments. Obtained results are of the same trend at both seasons. Similar results were reported by Hornok (1979) and Abou-Dahab et al. (1984) both on coriander, Atanasov et al. (1976) on dill, El-Sahhar (1977) and Hornok (1979) on mint plants. Moreover, concerning the production of volatile oil from seeds, obtained results are supported by Golcz et al. (1965), Singh et al. (1971), Hornok (1979), and Abou-Dahab et al. (1984) all working on coriander plants.

As a conclusion, application of 60 kg N + 32 kg $P_2O_5$/fed. could be recommended as the most desirable treatments to obtain high yield of volatile oils from both herb and seeds of coriander plants.

VI.1.4. N,P,K and total carbohydrates content in herb of coriander plants :

Data of Table (4) show that increasing N fertilizer from 0 up to 60 kg N/feddan significantly increased N,P and K as well as total carbohydrates contents of coriander herbs. It is evident that the highest values of each are associated with the highest used rate of N (60 kg N/feddan). Obtained data are going in the same trend at both seasons. Such results may be attributed to the increase in plant growth

(Table 1) which inturn increased the efficiency of the uptake of the plant to N,P and K. Obtained results are in agreement with those reported by El-Gamassy and El-Sayed (1977) working on Coriander, Othman (1972) on fennel, Hansen (1978) on different vegetables plants, Abd Alla et al. (1981) on Spinach and Farag (1984) on both of squash and pepper plants. With regard to the improving effect of nitrogen fertilizer on the total carbohydrates content of plant foliage obtained results are in confirmity with those reported by Abou-Dahab et al. (1984) on Coriander, Eid (1980) on squash, Abd Alla et al. (1981) on Spinach and Farag (1984) on both of squash and pepper plants.

Concerning the effect of phosphorus fertilizer on N,P,K and total carbohydrates content of herb, data presented in Table (4) clearly reveal that marked increases in this respect are detected as a result of increasing phosphorus fertilizer rate. It is clearly evident that the highest values of minerals (N,P and K) and total carbohydrates contents of coriander herb were obtained from plants treated with the highest rate of P-fertilizer (48 kg $P_2O_5$/feddan). However, differences between the highest two levels of P (32 and 48 kg $P_2O_5$/feddan) were not significant in the second season only. This indicates that using a rate of 32 kg $P_2O_5$/feddan will be more practical if the herb content of N,P,K and carbohydrates was taken in concern. Moreover, it is obvious

also that the obtained data are going in the same trend in the two seasons. The favourable effect of P-fertilizer on mineral content of herb has been reported by Abou-Dahab et al. (1984) and Hanafy (1984) working on coriander, Singh and Singh (1970) on mint and Farag (1984) on both of squash and pepper plants. With regard to carbohydrates content, similar results were obtained by Hanafy (1984) working on coriander, Mahmoud (1970) on mint and Farag (1984) on squash and pepper plants.

Regarding the combined effect of N and P-fertilizers, data illustrated in Table (4) clearly show that application of the highest used level of nitrogen fertilizer (60 kg N/ feddan) with moderate level of P-fertilizers (32 kg $P_2O_5$/ feddan) gave the highest values of N,P,K and total carbohydrates content of coriander herb. Similar results were reported by Decheva et al. (1980) working on mint, Omer (1980) on Khilla (Ammi visnaga L.) and Farag (1984) on squash and pepper plants regarding effect of N and P fertilizers on plant mineral content. Concerning total carbohydrates content, similar results were reported by Farag (1984) on both squash and pepper plants.

It may concluded that, the application of 60 kg N + 32 kg $P_2O_5$/feddan seemed to be the most effective treatment for increasing the N,P and K as well as total carbohydrates contents of coriander herb.

IV.1.5. N,P,K and total carbohydrates content of coriander seeds :

Data shown in Table (5) illustrate that increasing the rate of N fertilizer from 0 up to 60 kg N/feddan significantly increased NPK and total carbohydrates content of coriander seeds. It is also obvious that the highest values of such constituents in seeds are associated with the highest level of N fertilizer (60 kg N/feddan). Such enhancing effect was observed at both seasons of this experiment. Similar results were reported by Hanafey (1984) working on coriander, Omer (1980) on khilla and Farag (1984) on both squash and pepper plants. They stated that the highest values of N,P and K content are obtained when high levels of N-fertilizer were used. With regard to the carbohydrates content, obtained results are in agreement with those of Abou-Dahab et al. (1984) working on coriander, Farag (1984) on pepper, and Khalil et al. (1985) on snap beans.

Concerning the effect of P-fertilizer on N,P,K and total carbohydrates content in coriander seeds, data in Table (5) show that increasing P-fertilizer rates significantly increased NPK and total carbohydrates content of coriander seeds compared with those of the control plants at both seasons of this study. The data show also that the highest values of such constituents were associated with the highest

Table (5): Effect of different rates of nitrogen and phosphorus fertilizers on NPK and total carbohydrates content (mg/100 g seed) of coriander plants.

| Fertilizers | | First season 1985/86 | | | | Second season 1986/87 | | | |
|---|---|---|---|---|---|---|---|---|---|
| N kg/fed. | $P_2O_5$ kg/fed. | N | P | K | Total carbohydrates. | N | P | K | Total carbohydrates. |
| 0 | 0 | 1780 | 674 | 2882 | 813 | 1830 | 709 | 2918 | 859 |
| 20 | | 1860 | 686 | 2944 | 880 | 1915 | 720 | 2973 | 926 |
| 40 | | 1930 | 696 | 3012 | 934 | 1990 | 731 | 3034 | 980 |
| 60 | | 1990 | 707 | 3072 | 977 | 2040 | 741 | 3089 | 1021 |
| 0 | 16 | 1840 | 690 | 2906 | 851 | 1900 | 727 | 2946 | 899 |
| 20 | | 1970 | 721 | 2991 | 958 | 2040 | 759 | 3031 | 1000 |
| 40 | | 2110 | 749 | 3086 | 1062 | 2180 | 789 | 3121 | 1102 |
| 60 | | 2260 | 775 | 3186 | 1176 | 2310 | 820 | 3216 | 1224 |
| 0 | 32 | 1885 | 704 | 2926 | 871 | 1950 | 742 | 2968 | 922 |
| 20 | | 1995 | 732 | 3006 | 981 | 2070 | 766 | 3048 | 1032 |
| 40 | | 2125 | 760 | 3096 | 1079 | 2180 | 794 | 3133 | 1136 |
| 60 | | 2245 | 784 | 3191 | 1196 | 2300 | 822 | 3223 | 1242 |
| 0 | 48 | 1920 | 716 | 2946 | 879 | 1980 | 752 | 2988 | 930 |
| 20 | | 2020 | 738 | 3026 | 981 | 2100 | 772 | 3063 | 1030 |
| 40 | | 2130 | 760 | 3116 | 1086 | 2210 | 794 | 3148 | 1141 |
| 60 | | 2240 | 784 | 3196 | 1192 | 2300 | 814 | 3233 | 1246 |
| L.S.D. 1 % | | 31 | 22 | 16 | 23 | 27 | 12 | 12 | 21 |
| 0 kg N/fed. | | 1886 | 696 | 2915 | 853 | 1915 | 732 | 2955 | 903 |
| 20 kg N/fed. | | 1961 | 719 | 2991 | 950 | 2031 | 754 | 3028 | 997 |
| 40 kg N/fed. | | 2073 | 741 | 3077 | 1040 | 2140 | 777 | 3109 | 1090 |
| 6 kg N/fed. | | 2183 | 762 | 3161 | 1135 | 2237 | 799 | 3190 | 1184 |
| L.S.D. at 1 % | | 16 | 11 | 8 | 12 | 27 | 6 | 6 | 10 |
| 0 kg $P_2O_5$/fed. | | 1890 | 690 | 2977 | 901 | 1943 | 725 | 3003 | 946 |
| 16 kg $P_2O_5$/f. | | 2045 | 733 | 3042 | 1012 | 2107 | 773 | 3078 | 1057 |
| 32 kg $P_2O_5$/f. | | 2062 | 745 | 3054 | 1031 | 2125 | 781 | 3091 | 1083 |
| 48 kg $P_2O_5$/f. | | 2077 | 749 | 3071 | 1034 | 2147 | 783 | 3108 | 1087 |
| L.S.D. 1 % | | 16 | 11 | 8 | 12 | 27 | 6 | 6 | 10 |

IV. 1.6. Volatile oil components of coriander seeds :

The analysis of volatile oil and determination of the percentage of the main components which were carried out by Gas liquid chromatography showed that 15 different compounds may be recognized. The most important constituents of oil which were taken in consideration are, ∝ -pinene, B-pinene, dipentene, P-cymane, d-linalool and geraniol. Such components represented more than about 90 % of seeds oil content. Data presented at Table (6) show the effect of different rates of N and P fertilizers and their combination on volatile oil compounds of coriander seed oil. Concerning effect of N fertilizer rate on different determined oil fraction, it is evident that each of ∝ -pinene, B-pinene, P-cymene and dipentene were gradually decreased with increasing level of N application where the highest seed oil content of such constituents are observed with the control treatment (0 kg N/feddan). While the lowest content in this regard associated with the highest used rate of nitrogen (60 kg N/fed.) Regarding the effect of nitrogen fertilizer rate on d-linalool of seed oil content, it is evident that increasing N fertilizer rate increased d-linalool compound up to highest used level. Moreover, the geraniol in oil seed content was also increased with increasing N fertilizer rate, but up to 40 kg N/feddan.

With regard to the effect to P-fertilizer rate on the volatile oil components of seed, the same data show that both

Table (6): Effect of different rates of nitrogen and phosphorus fertilizers on volatile oil components as percentage of coriander seeds.

| Fertilizers | | Volatile oil | | | | | |
|---|---|---|---|---|---|---|---|
| N kg/fdd. | $P_2O_5$ kg/fed. | ∝-pinene | B-pinene | P-cymene | Dipen-tente | d-linalool | Geran-iol |
| 0 | | 7.07 | 7.62 | 9.81 | 3.23 | 57.13 | 3.64 |
| 20 | 0 | 6.81 | 8.21 | 9.60 | 0.70 | 61.45 | 3.52 |
| 40 | | 6.21 | 10.40 | 5.57 | 1.12 | 64.72 | 4.04 |
| 60 | | 0.07 | 3.20 | 3.10 | 1.16 | 82.10 | 2.14 |
| 0 | | 5.33 | 5.35 | 11.18 | 3.41 | 61.51 | 3.93 |
| 20 | 16 | 3.29 | 4.19 | 6.14 | 5.69 | 65.86 | 4.38 |
| 40 | | 5.01 | 3.61 | 7.13 | 2.73 | 66.76 | 5.01 |
| 60 | | 3.39 | 3.53 | 5.29 | 5.97 | 70.86 | 3.90 |
| 0 | | 7.67 | 6.35 | 7.10 | 0.69 | 62.89 | 4.18 |
| 20 | 32 | 4.51 | 6.76 | 6.98 | 0.20 | 67.28 | 3.60 |
| 40 | | 0.48 | 9.76 | 13.69 | 2.38 | 69.86 | 4.64 |
| 60 | | 1.75 | 4.79 | 7.36 | 0.98 | 73.28 | 4.10 |
| 0 | | 0.30 | 8.02 | 5.42 | 3.57 | 65.73 | 4.10 |
| 20 | 48 | 6.96 | 3.31 | 9.92 | 1.30 | 68.93 | 5.42 |
| 40 | | 3.52 | 2.05 | 4.10 | 7.33 | 70.04 | 3.22 |
| 60 | | 1.90 | 0.10 | 10.45 | 2.88 | 73.15 | 4.01 |
| 0 | | 5.09 | 6.84 | 8.38 | 2.68 | 61.82 | 3.71 |
| 20 | | 5.39 | 5.90 | 8.16 | 1.97 | 65.88 | 4.23 |
| 40 | | 3.81 | 6.45 | 7.63 | 3.39 | 67.85 | 4.24 |
| 60 | | 1.78 | 2.90 | 6.55 | 2.75 | 74.85 | 3.54 |
| | 0 | 5.04 | 7.36 | 7.02 | 1.55 | 66.35 | 3.34 |
| | 16 | 4.26 | 4.17 | 7.44 | 4.45 | 66.25 | 4.31 |
| | 32 | 3.60 | 6.92 | 8.78 | 1.06 | 68.33 | 4.24 |
| | 48 | 3.17 | 3.37 | 7.47 | 3.72 | 69.46 | 4.19 |

of ∝ -pinene and B-pinene constituents were decreased with increasing P-fertilizer rate. The control treatment showed the highest content in this respect. However, both of P-cymene and dipentene were slightly increased with P-fertilizer application compared with the control treatment. Where either 16 kg $P_2O_5$/feddan in case of Dipentene or 32 kg $P_2O_5$/feddan in case of P-cymene gave the highest values in this respect. With regard to d-linalool compound of coriander seed oil, data at the same Table show that using 48 kg $P_2O_5$/feddan resulted in the highest content in this respect. Moreover, similar results may be observed in case of geraniol compound, but only when P-fertilizer was used at 16 - 32 kg $P_2O_5$/feddan.

Regarding the combined effect of N and P-fertilizers on both compounds of ∝ -pinene and B-pinene of coriander seed oil, no clear trend may be detected where most of the used fertilizer rates and their combination did not show a remarkable increase in this respect. However, on the contrary the control treatment showed the highest values of such compounds. The same data show that concerning P-cymene compound of seed oil content, it is evedent that using 40 kg N/feddan combined with 32 kg $P_2O_5$/feddan showed the highest value compared with other treatments. Moreover, using 40 kg N combined with 48 $P_2O_5$/feddan resulted in the highest dipentene compound. Concerning d-linalool and geraniol compounds of coriander seed

oil, data showed that the highest content of both compounds are obtained from seed oil of plants fertilized with 20 - 40 kg N and 16 - 32 kg $P_2O_5$/feddan. Obtained results are in agreement with those reported by Abou-Dahab et al. (1984) regarding the effect of N and P fertilizer on the d-linalool content of coriander seed oil, they reported that the highest used level of both N and P fertilizer was associated with the highest linalool compound of seed oil of coriander.

Finally, it may be concluded that when $\alpha$ -pinene and B-pinene are considerable, neither N nor P-fertilizer are of economic effect in this respect. Moreover, when P-cymene compound is needed, it is advicable to fertilize coriander plants with 40 kg N and 32 kg $P_2O_5$/feddan to obtain seeds of the highest values in this respect. Moreover, application of 40 kg N + 48 kg $P_2O_5$/feddan may be recommended when dipentene compound is required. The d-linalool compound which represented the major compound of seed volatile oil of coriander (60 - 80 %) and also the geraniol compound which were clearly affected by N and P fertilizers rate may be extracted from coriander seeds oil at the highest possible values when plants were fertilized with 40 - 60 kg N combined with 16 - 32 kg $P_2O_5$/feddan. Hence, such treatment may be recommended as the most suitable fertilization program of coriander production for seed oils extraction

## IV.2. Second Experiment :

Effect of different rates of $GA_3$, NAA or CCC foliar spray on vegetative growth of coriander plants herb and seed yield as well as its chemical constituents.

### IV.2.1. Vegetative growth of plants :

Data presented in Table (7) show that the different rates of growth regulators used in this experiment, except those of CCC, significantly increased plant height, moreover, plant fresh weight and dry percentage in herb were significantly increased than the control treatments. It is also evident that the highest values of mentioned characteristics were obtained at 100 - 200 ppm of $GA_3$ except for dry weight which showed its highest values at 50 or 100 ppm $GA_3$ and 1000 or 2000 ppm of CCC. However, differences between the highest two levels of $GA_3$ (100 and 200 ppm) were not significant. In this respect, $GA_3$ at 100 ppm was the most effective treatment, since it was associated with the highest values in general. Table (1) clearly shows also that obtained results are going in the same trend at both seasons of this work. Many investigators working on the effect of $GA_3$ foliar spray on vegetative growth of different leafy crops among them, Ahmed and Eid (1975) working on fennel, caraway, anis and cumin, Shoushan *et al.* (1980) on adonis, and El-Mazny and Badran (1984) on cumin. They reported that $GA_3$ spray increased plant

Table (7): Effect of different rates of $GA_3$, NAA or CCC foliar spray on vegetative growth of coriander plants.

| Treatments | ppm | First season 1985/86 | | | Second season 1986/87 | | |
|---|---|---|---|---|---|---|---|
| | | Plant height (cm) | Fresh weight (gm/plant) | Dry weight % | Plant height (cm) | Fresh weight (gm/plant) | Dry weight % |
| $GA_3$ | 0 | 50.0 | 160.3 | 11.9 | 54.0 | 175.0 | 12.2 |
| | 25 | 51.5 | 160.9 | 12.2 | 55.5 | 176.9 | 12.3 |
| | 50 | 53.0 | 163.1 | 12.8 | 57.5 | 180.0 | 13.0 |
| | 100 | 56.5 | 169.7 | 13.0 | 61.0 | 186.2 | 12.9 |
| | 200 | 57.0 | 170.3 | 12.2 | 61.5 | 187.5 | 12.4 |
| NAA | 50 | 51.0 | 160.0 | 12.1 | 55.3 | 176.3 | 12.5 |
| | 100 | 52.5 | 163.8 | 12.7 | 58.5 | 180.0 | 12.8 |
| | 150 | 55.0 | 168.5 | 12.7 | 60.0 | 182.5 | 12.7 |
| | 200 | 56.0 | 168.6 | 12.4 | 61.0 | 183.5 | 12.6 |
| CCC | 250 | 50.0 | 160.9 | 12.2 | 53.0 | 175.2 | 12.4 |
| | 500 | 48.5 | 165.0 | 12.6 | 51.0 | 177.5 | 12.9 |
| | 1000 | 46.5 | 168.8 | 12.9 | 48.0 | 181.9 | 13.2 |
| | 2000 | 45.6 | 166.3 | 12.9 | 47.0 | 181.0 | 12.9 |
| L.S.D. at 5 % | | 1.3 | 2.6 | 0.3 | 1.2 | 1.9 | 0.3 |

height. Regarding the improving effect of different rates of $GA_3$ on plant fresh weight and dry matter percentage, similar results were obtained by James and Sciuchetti (1964), on datura, Shah and Srivastiva (1967) on digitala, Abou-Zeid and Sherbeeny(1974) on Chamomile and Shoushan et al. (1980) on adonis.

Obtained results at Table (7) indicate also that using 150 ppm of NAA is enough to obtain the highest values of the studied vegetative growth characters. Such results are in agreement with those reported by Shoushan et al. (1980) on adonis, Vandysheva (1983) on Sage and Farag (1984) on both squash and pepper plants.

Regarding the effect of different concentrations of CCC spray on plant growth of coriander plants, data in Table (7) show also that increasing the concentration of foliar spray of CCC especially at 1000 ppm increased fresh weight of plant and dry matter percentage of herb than those of control plants, but decreased plant height. These findings are in agreement with those of Abou-Zeid and Sherbeeeny (1971) working on chamomile, Ahmed and Eid (1975) on some umbelliferae plants, Waglarz (1983) on coriander and Shedeed et al. (1984) on mint plants.

From previous data, it can be concluded that the foliar spray of $GA_3$ at concentration of 100 ppm, NAA at 150 ppm or CCC at 1000 ppm on coriander plants (three times starting 20 days after seed sowing and at two weeks intervals) resulted in the highest values of vegetative growth characteristics.

IV.2.2. Fresh herb and seed yield of coriander plants and quality of seeds :

Data shown in Table (8) and Fig. (3) illustrate the effect of different rates of $GA_3$, NAA and CCC foliar application on fresh herb and seed yield/feddan as well as seed index. It is obvious that high used levels of growth substances significantly increased all studied yield characteristics. Such improving effect is clearly evident at both seasons of this experimental work. It is also obvious that foliar spray of 100 ppm of $GA_3$, 150 ppm NAA or 1000 ppm CCC, resulted in the highest values of herb and seed yield as well as seed index. Concerning effect of $GA_3$ on herb yield, similar results were obtained by James and Sciuchetti(1964) on datura, Shah and Srivastava (1967) on digitala, Abou-Zeid and Sherbeeny (1974) on chamomile and Shoushan et al. (1980) on adonis. Regarding the effect of $GA_3$ on seed yield and quality, El-Mazny and Badran (1984) on cumin, and Farag (1984) on both squash and pepper plants reported that $GA_3$ foliar spray on such crops increased total seed yield and improved size and weight of 100 seeds.

Table (8): Effect of different rates of $GA_3$, NAA or CCC foliar spray on fresh herb and seed yield and quality of seed of coriander plants.

| Treatment | ppm | First season 1985/86 | | | | Second season 1986/87 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Herb yield (ton/fed.) | Seed yield (gm/pl.) | Seed yield (kg/fed.) | 100 seed weight (gm) | Herb yield (ton/fed.) | Seed yield (gm/pl.) | Seed yield (kg/fed.) | 100 seed weight (gm) |
| $GA_3$ | 0 | 20.52 | 10.0 | 1280 | 1.36 | 22.40 | 10.6 | 1352 | 1.38 |
| | 25 | 20.60 | 10.1 | 1296 | 1.36 | 22.62 | 10.7 | 1372 | 1.39 |
| | 50 | 20.88 | 10.4 | 1328 | 1.39 | 23.04 | 10.9 | 1392 | 1.40 |
| | 100 | 21.72 | 10.6 | 1360 | 1.42 | 23.84 | 11.2 | 1432 | 1.44 |
| | 200 | 21.80 | 10.5 | 1344 | 1.40 | 24.00 | 11.2 | 1432 | 1.41 |
| NAA | 50 | 20.56 | 10.3 | 1312 | 1.38 | 22.56 | 10.7 | 1368 | 1.40 |
| | 100 | 20.96 | 10.5 | 1344 | 1.41 | 23.04 | 10.9 | 1400 | 1.42 |
| | 150 | 21.56 | 10.7 | 1360 | 1.44 | 23.36 | 11.1 | 1416 | 1.45 |
| | 200 | 21.58 | 10.7 | 1360 | 1.42 | 23.48 | 11.1 | 1424 | 1.44 |
| CCC | 250 | 20.60 | 10.1 | 1296 | 1.38 | 22.42 | 10.7 | 1368 | 1.40 |
| | 500 | 21.12 | 10.3 | 1320 | 1.42 | 22.72 | 10.9 | 1380 | 1.44 |
| | 1000 | 21.60 | 10.5 | 1344 | 1.44 | 23.20 | 11.1 | 1424 | 1.45 |
| | 2000 | 21.28 | 10.5 | 1344 | 1.44 | 23.00 | 11.1 | 1424 | 1.45 |
| L.S.D. at 5 % | | 0.546 | 0.2 | 31 | 0.02 | 0.436 | 0.2 | 24 | 0.02 |

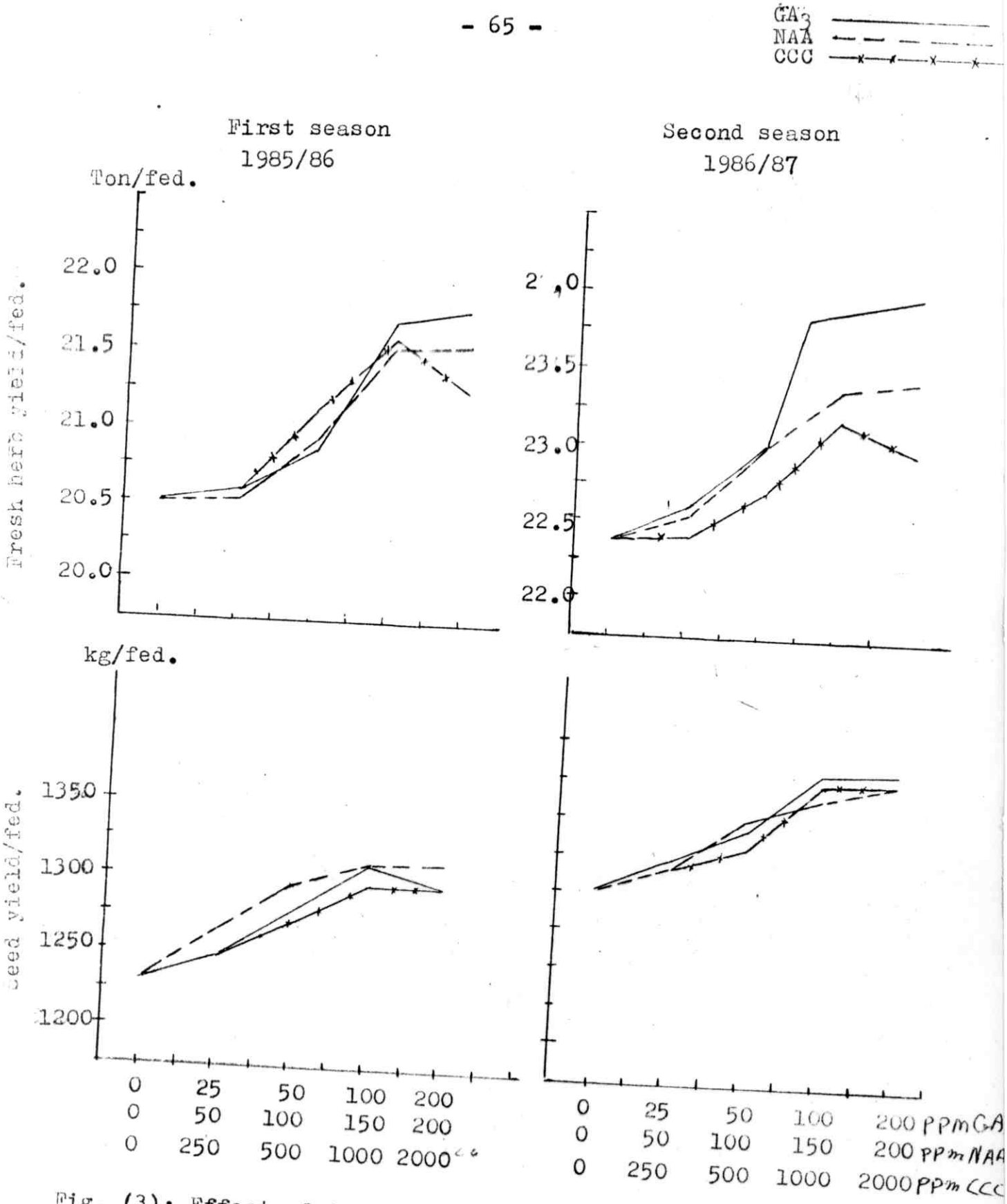


Fig. (3): Effect of different concentrations of $GA_3$ , NAA and CCC foliar spray on fresh herb yield (ton/fed.) and seed yield (kg/fed.) of coriander plants.

Regarding the effect of NAA on herb yield, obtained results are in agreement with those of Shoushan et al. (1980) on adonis, Zaki et al. (1981) on tomato, Abd Alla et al. (1984) on pepper and Farag (1984) on both squash and pepper plants. Concerning the effect of NAA on seed yield and quality, Shoushan et al. (1980) on adonis, Vandysheva (1983) on sage and Farag (1984) on squash and pepper plants stated that NAA foliar spray promoted seed production and improved seed quality.

Respecting the effect of CCC on fresh herb yield, obtained results in this work are in accordance with those of Waglarz (1983) on coriander, Abou-Zeid and Sherbeeny (1971) on chamomile, Shedeed et al. (1984) on mint, Abd-Alla et al. (1979) on squash and snake cucumber and Zaki et al. (1979) on tomato. With regard to the effect of CCC on seed yield and seed quality, obtained results are in accordance with those reported by Waglarz (1983) on coriander and El-Mazny and Badran (1984) on cumin.

Finally, it may be concluded that foliar spray of 100 ppm $GA_3$, 150 ppm NAA or 1000 ppm CCC on coriander plants may be recommended for getting the highest yield either as fresh herb (ton/feddan) or seed (kg/feddan) with better seeds.

IV.2.3. Volatile oils content and total carbohydrates perconage in herb of coriander plants :

Data presented in Table (9) and Fig. (4) show clearly that the highest concentrations of each of $GA_3$ (100-200 ppm), NAA (150-200 ppm) and CCC (1000 - 2000 ppm) significantly increased the volatile oils percentage and total oil content as well as percentage of total carbohydrates in coriander plants herb. Obtained results show the same trend at both seasons of this study. Data show also that increasing NAA level more than 150 ppm or CCC level more than 1000 ppm was of insignificant effect on volatile oil and total carbohydrates content of coriander plant herb. In this concern, Abou-Zeid and Sherbeeny (1974) working on chamomile stated that increasing $GA_3$ level increased volatile oils content, however 75 ppm level was more effective. Eid and Ahmed (1976) working on basil and Bosila and Udalova (1977) on mint, reported similar results. Moreover, Amrutavalli (1979) on coriander, Farag (1984) on both of squash and pepper, Khafagi et al. (1986)on both of bean and cowpea and Sharaf et al. (1986) on bean plants, indicated that $GA_3$ spray at 50 or 100 ppm enhanced the accumulation of total carbohydrates in plant foliage. Obtained results, regarding the effect of NAA spray on volatile oils content of herb are in agreement with those reported by Koseva and Stanev (1978) and Bosila and Udalova (1977) all

Table (9): Effect of different levels of $GA_3$, NAA and CCC foliar spray on volatile oils content and percentage of total carbohydrates on the base of dry weight in corinader herb.

| Treatments | ppm | First season 1985/86 | | | Second season 1986/87 | | |
|---|---|---|---|---|---|---|---|
| | | Volatile oil content | | Total carbohydrates % | Volatile oil content | | Total carbohydrates % |
| | | (ml/100 g) | (Lit/fed.) | | (ml/100 g) | (Lit/fed.) | |
| $GA_3$ | 0 | 0.020 | 4.101 | 3.031 | 0.021 | 4.758 | 3.062 |
| | 25 | 0.021 | 4.380 | 3.062 | 0.022 | 4.944 | 3.093 |
| | 50 | 0.024 | 4.700 | 3.093 | 0.024 | 5.468 | 3.135 |
| | 100 | 0.030 | 6.248 | 3.103 | 0.029 | 6.550 | 3.156 |
| | 200 | 0.026 | 5.452 | 3.103 | 0.025 | 6.000 | 3.146 |
| NAA | 50 | 0.021 | 4.368 | 3.052 | 0.023 | 5.070 | 3.083 |
| | 100 | 0.024 | 4.980 | 3.083 | 0.025 | 5.749 | 3.124 |
| | 150 | 0.026 | 5.657 | 3.103 | 0.026 | 6.128 | 3.146 |
| | 200 | 0.028 | 5.932 | 3.093 | 0.028 | 6.452 | 3.135 |
| CCC | 250 | 0.021 | 4.362 | 5.042 | 0.021 | 4.761 | 3.072 |
| | 500 | 0.023 | 4.746 | 3.072 | 0.024 | 5.394 | 3.103 |
| | 1000 | 0.025 | 5.386 | 3.093 | 0.026 | 6.083 | 3.146 |
| | 2000 | 0.026 | 5.570 | 3.114 | 0.026 | 6.030 | 3.156 |
| L.S.D. 5 % | | 0.002 | 0.874 | 0.038 | 0.002 | 0.436 | 0.039 |

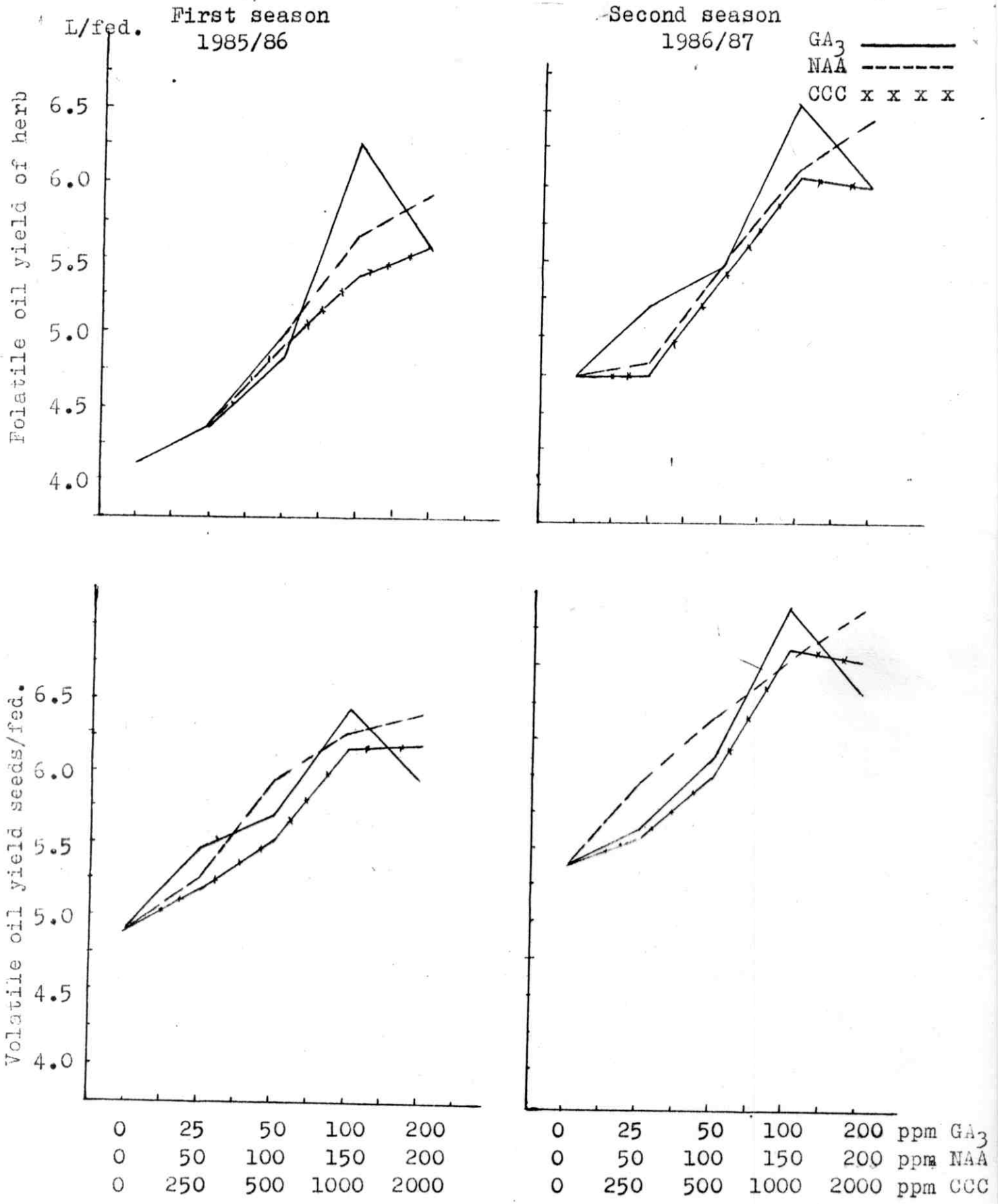


Fig (4)Fig.(4): Effect of different concentrations of $GA_3$, NAA and CCC foliar spray on volatile oil yield of herb and seeds (L/fed.) of coriander plants.

working on mint plants. Moreover, Farag (1984) found that NAA at 100 ppm increased sugar concentration in leaves of squash and pepper plants.

The remarkable enhancing effect of 1000 ppm of CCC on volatile oils and total carbohydrates content of coriander herb was also reported by Waglarz (1983) on coriander, Eid and Ahmed (1976) on cumin and Shedeed et al. (1984) on mint. They stated that the foliar spray of CCC improved oil content of plant herb. With regard to the effect of CCC spray on total carbohydrates content, El-Baz et al. (1979) working on potato, Zaki et al. (1979) on tomato and Mahmoud (1983) on pepper, all found that high levels of CCC spray (1000 or 1500 ppm) increased total carbohydrates content.

Therefore, such concentrations of $GA_3$ (100 ppm), NAA (150 ppm) or CCC (1000 ppm) could be recommended as the most practical and effective levels for increasing the yield of volatile oils and percentage of carbohydrates of coriander herbs.

### IV.2.4. Volatile oils content and total carbohydrates percentage of coriander seeds :

Data illustrated at Table (10) and Fig. (4) show the effect of different concentrations of some growth regulators on volatile oils percentage and oil yield and total

Table (10): Effect of different rates of $GA_3$, NAA and CCC foliar spray on volatile oils percentage total oil yield as well as total carbohydrates percent on the base of dry weight in seeds of coriander plants.

| Treatments | ppm | First season 1985/86 | | | Second season 1986/87 | | |
|---|---|---|---|---|---|---|---|
| | | Volatile oil content | | Total carbohydrates % | Volatile oil content | | Total carbohydrates % |
| | | (ml/100 g) | (Lit./fed.) | | (ml/100 g) | (Lit/fed.) | |
| $GA_3$ | 0 | 0.38 | 4.897 | 1.234 | 0.40 | 5.372 | 1.192 |
| | 25 | 0.40 | 5.438 | 1.238 | 0.41 | 5.623 | 1.200 |
| | 50 | 0.43 | 5.676 | 1.252 | 0.44 | 6.124 | 1.211 |
| | 100 | 0.48 | 6.532 | 1.260 | 0.50 | 7.158 | 1.227 |
| | 200 | 0.44 | 5.948 | 1.272 | 0.46 | 6.586 | 1.238 |
| NAA | 50 | 0.40 | 5.250 | 1.242 | 0.43 | 5.951 | 1.203 |
| | 100 | 0.44 | 5.918 | 1.254 | 0.46 | 6.402 | 1.215 |
| | 150 | 0.46 | 6.258 | 1.262 | 0.48 | 6.794 | 1.224 |
| | 200 | 0.47 | 6.399 | 1.274 | 0.50 | 7.119 | 1.223 |
| CCC | 250 | 0.40 | 5.186 | 1.248 | 0.41 | 5.574 | 1.211 |
| | 500 | 0.42 | 5.510 | 1.262 | 0.44 | 6.111 | 1.230 |
| | 1000 | 0.46 | 6.147 | 1.270 | 0.48 | 6.835 | 1.238 |
| | 2000 | 0.46 | 6.184 | 1.282 | 0.46 | 6.548 | 1.250 |
| L.S.D. 5 % | | 0.03 | 0.416 | 0.009 | 0.03 | 0.302 | 0.008 |

carbohydrates percentage of coriander seeds. Such data clearly reveal that the volatile oils percentage, total oils yield and total carbohydrates percentage of coriander seeds significantly increased with increasing $GA_3$ concentrations (up to 100 ppm), NAA (up to 150 ppm) and CCC (up to 1000 ppm) more than those of control and other treatments at both seasons of this work. It is also evident that the highest level of $GA_3$ (200 ppm) decreased the volatile oil percentage and consequently oil yield comparing to 100 ppm level, while higher concentrations of either NAA (200 ppm) or CCC (2000 ppm) gave slight increments in this respect but without significant differences. Therefore, spraying coriander plants with 100 ppm of $GA_3$, 150 ppm of NAA or 1000 ppm of CCC could be considered as adequate levels to increase volatile oils and total carbohydrates content in seeds of coriander plants. Respecting the volatile oils content of seeds as affected by $GA_3$ foliar spray, similar results were obtained by Kaul and Kapoor (1982) working on dill, Abou-Zeid and Sherbeeny (1974) on chamomile and Ahmed and Eid (1975) on some umbelliferae plants. With regard to the effect of $GA_3$ on total charbohydrates content of seed, obtained results are confirmed by those of Farag (1984) on fruits of pepper and Sharaf et al. (1986) on seeds of bean and rice plants.

The improving effect of NAA as foliar spray, especially at moderate concentration (150 ppm) on seed volatile oils

yield, was due to obtained higher volatile oils percentage, higher seed yield and consequantly oil yield. The higher accumulation of total carbohydrates in seeds as a result of spraying plants with NAA was found by Zaki et al. (1981) in tomato fruits and Farag (1984) in both of squash and pepper seeds.

The superiority of seeds bearing volatile oil produced from plants treated with CCC was found by Waglarz (1983) on coriander, Abou-Zeid and Sherbeeny (1971) and Haikel and Badr (1982) both on chamomile.

Concerning the effect of CCC on total carbohydrates content in seeds, obtained results in this respect are in confirmity with those reported by Zaki et al. (1979) working on tomato, El-Baz et al. (1979) on potato and Mahmoud (1983) on pepper.

From previous data, it may be concluded that foliar spray (three times, starting 20 days after seed sowing and at intervals of two weeks) of $GA_3$, NAA or CCC at concentrations of 100, 150 or 1000 ppm, respectively, were effective to obtain high values of volatile oils yield and carbohydrates content in coriander seeds.

yield, was due to obtained higher volatile oils percentage, higher seed yield and consequantly oil yield. The higher accumulation of total carbohydrates in seeds as a result of spraying plants with NAA was found by Zaki et al. (1981) in tomato fruits and Farag (1984) in both of squash and pepper seeds.

The superiority of seeds bearing volatile oil produced from plants treated with CCC was found by Waglarz (1983) on coriander, Abou-Zeid and Sherbeeny (1971) and Haikel and Badr (1982) both on chamomile.

Concerning the effect of CCC on total carbohydrates content in seeds, obtained results in this respect are in confirmity with those reported by Zaki et al. (1979) working on tomato, El-Baz et al. (1979) on potato and Mahmoud (1983) on pepper.

From previous data, it may be concluded that foliar spray (three times, starting 20 days after seed sowing and at intervals of two weeks) of $GA_3$, NAA or CCC at concentrations of 100, 150 or 1000 ppm, respectively, were effective to obtain high values of volatile oils yield and carbohydrates content in coriander seeds.

IV. 2.5. Volatile oil components of coriander seeds :

Data presented at Table (11) illustrate that each of $\alpha$-pinene, B-pinene and geraniol compounds of coriander seed oil were decreased as a result of different used concentrations of either $GA_3$, NAA and CCC foliar spray except 500 ppm of CCC which showed the highest values of B-pinene in this respect. Similar results may be detected from the same data regarding P-cymene compound where all used concentrations of different used growth regulators were uneffective in this regard except 500 ppm of CCC spray which clearly showed the highest values of this compound. Contra results may be recognized regarding dipentene and d-linalool compounds which showed higher values with different used concentrations of such used growth regulators compared with control treatment. It is also evident that the highest values of d-linalool compound may be recognized with 100 - 200 ppm $GA_3$, 100 - 150 ppm NAA, and 1000 - 2000 ppm CCC foliar spray. Such obtained results of different volatile oil components of coriander seed oil show that different rates of some growth regulators i.e. $GA_3$, NAA, and CCC foliar spray were of variable effect on such components where some of them were decreased ($\alpha$-pinene, B-pinene, and geraniol) others were not affected as P-cymene and the later as dipentene and d-linalool were clearly increased. These results are in conformity with those reported by Kaul and Kapoor (1962) on dill and

Table (11): Effect of different rates of $GA_3$, NAA or CCC foliar spray on volatile oil components as percentage of coriander seeds.

| Treatments | | Volatile oil fraction | | | | | |
|---|---|---|---|---|---|---|---|
| | ppm | ∝-pinene | B-pinene | P-cymene | Dipentene | d-linalool | Geraniol |
| $GA_3$ | 0 | 1.75 | 4.79 | 7.36 | 0.98 | 73.28 | 4.10 |
| | 25 | 1.40 | 4.22 | 7.80 | 1.56 | 73.34 | 3.60 |
| | 50 | 1.03 | 3.81 | 6.41 | 1.70 | 74.06 | 3.60 |
| | 100 | 1.40 | 3.50 | 7.22 | 2.00 | 76.54 | 3.12 |
| | 200 | 1.40 | 1.40 | 7.40 | 1.22 | 77.39 | 4.00 |
| NAA | 50 | 1.40 | 4.20 | 7.65 | 1.04 | 73.84 | 3.52 |
| | 100 | 1.66 | 4.00 | 7.24 | 1.34 | 75.96 | 3.31 |
| | 150 | 1.64 | 3.92 | 7.30 | 1.86 | 75.18 | 3.40 |
| | 200 | 1.56 | 3.60 | 7.15 | 1.41 | 74.73 | 3.62 |
| CCC | 250 | 1.32 | 4.26 | 7.71 | 1.54 | 73.44 | 3.66 |
| | 500 | 1.60 | 5.72 | 10.22 | 1.88 | 72.85 | 4.06 |
| | 1000 | 1.68 | 3.44 | 7.06 | 1.66 | 77.82 | 3.11 |
| | 2000 | 1.76 | 0.10 | 7.04 | 2.30 | 76.14 | 4.08 |

Abou-Zeid and Sherbeeny (1974) on chamomile regarding effect of $GA_3$ on seed oil compounds; Abou-Zeid and Sherbeeny (1971) reported also similar results regarding the effect of CCC foliar spray on the chamomile seeds oil components.

As a general conclusion, it is advicable to spray coriander plants three times at 3,5 and 7 weeks after seed sowing with 100 - 200 ppm $GA_3$, 100 - 150 ppm of NAA, or 1000 - 2000 ppm CCC, as foliar spray to obtain seeds volatile oil bearing high values of different components especially d-linalool and dipentence.