

INTERCROPPING CHINESE GARLIC WITH FENNEL, CORIANDER OR CARAWAY PLANTS

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ABSTRACT

A field experiment was established to evaluate the effect of intercropping Chinese garlic with fennel, coriander or caraway plants on the growth, yield, oil content and economic return of these species. The experiment was conducted at the Experimental Farm of the Desert Development Center, American University in Cairo (DDC, AUC) in South Tahrir during the two successive seasons of 1999/2000 and 2000/2001. The obtained results showed that, the growth characters (No. of branches & leaves/plant, fresh & dry weights/plant, No. of cloves/bulb & umbels/plant, clove weight and weight of 100 fruits) of intercropped plants were significantly decreased by intercropping, while the plant height of fennel, coriander or caraway was slightly increased. Intercropping significantly decreased the yield of each crop as compared to the pure stand treatments of each one. On contrary, the intercropping treatments increased the productivity/feddan (net profit) than pure stand treatments, except intercropping Chinese garlic with fennel, which produced less monetary return than pure stand of Chinese garlic. Essential oil percentage of Chinese garlic tended to decrease due to intercropping, while it was not affected in fennel, coriander or caraway. The main components of essential oil of studied plants were not substantially affected by intercropping treatments. However, land equivalent ratio was greater than one. Intercropping Chinese garlic with coriander is recommended to obtain the highest value of land equivalent ratio and land usage, followed by caraway and fennel, respectively.

Keywords : Intercropping, interplanting, garlic, fennel, coriander, caraway, Liliaceae, Apiaceae

INTRODUCTION

Garlic (*Allium sativum* L., Fam. Liliaceae) is one of the major vegetables for local consumption and exportation. Also, garlic considered as a main crop for its critical sanitation role in the public health. Garlic has been used for many medicinal purposes including use as hypoglycemic agent (Brahmachari and Augusti, 1962), a hypocholesterolemic agent (Augusti, 1977), an anti-spasmodic agent (Lio and Agnoli, 1927) and anti-hypertensive agent (Velasquez *et al.*, 1958).

Fennel (*Foeniculum vulgare*), Coriander (*Coriander sativum*) and Caraway (*Carum carvi*) plants, Fam. Apiaceae. They considered as the most important spice plants. These plants are cultivated in winter as annual plants and their fruits appear in summer season.

Dried ripe fruits of fennel and its volatile oil are used as a flavouring agent, carminative, stimulant and condiment.

Fruits and oil of coriander plant are employed widely in gin essences and for flavouring of all kinds of food products, sauces, soups, baked goods

and confectionery. Oil is used also in pharmaceutical and other preparations for covering disagreeable odor and taste.

Caraway fruits are used for flavouring bread, cakes, confectionery, cheese, sausages, canned goods, soaps, meat and all kinds of food products. Oil of caraway is used in oral preparations, to overcome the unpleasant odor or taste. Oil is considered also as a mild stomachic and carminative.

Intercropping may be considered as one of the most effective methods followed in Egypt to maximise the output of the limited cultivated lands. Results of many researchers found that, maximum net profit could be obtained from the same area if two crops were interplanted together without aggressive competition between them. Haq *et al* (1997) reported that intercropping garlic with tomato increased the benefit / cost ratio than that of garlic or tomato monocropping. The land equivalent ratio (L.E.R) of the intercropping system was greater than one. Nikam *et al* (1988) demonstrated that intercropping coriander with safflower in a 2/1 ratio gave the maximum monetary return. Singh *et al* (1999) reported that intercropping sugarcane with garlic or fennel gave the highest net return and benefit/cost ratio than those of sole crops.

Also, intercropping is used as a control of insects. Naganathan *et al* (1988) stated that, the populations of *Radopholus similis* and *Pratylenchus coffeae* on banana roots were significantly reduced by growing antagonistic crops such as tagetes or coriander. Varun *et al* (1990), found that when sugarcane was intercropped with spice crops, namely coriander, caraway, onion, garlic, fenugreek, fennel and black cumin, the incidence of the pyralid was significantly reduced. In addition, the intercropping system is used as a weed control (living cover) and use also to minimize the irrigation water.

El-Gamal *et al* (1984) concluded that, onion and garlic were suitable combinations as intercrops with geranium. Haridy *et al* (1990) indicated that the yield of coriander fruits and the oil yield per plant were significantly decreased by intercropping with cabbage, lettuce or radish. Al-Masry *et al* (1990) concluded that intercropping slightly reduced herbage and oil of both dill and peppermint compared with pure stand crops. Seed oil yield of dill was slightly reduced. G.L.C. analysis proved that the oil composition of the studied crops was not affected by intercropping. Ram and Kumar (1998) stated that the quality of geranium essential oil in terms of its major constituent, citronellol, was not affected by intercropping with garlic, onion, coriander, mustard or wild marigold. El-Gamal *et al* (1988) reported that plant height, number of fruits/plant, yield of fresh and dry sepals and organic acids percentage in roselle plant were slightly decreased, while Anthocyanine content was significantly decreased by intercropping with sesame. Eid and El-Gizy (1995) found that plant growth of safflower significantly decreased by intercropping with broad bean. Plant height of broad bean was significantly increased by intercropping, while the yield was decreased. Land equivalent ratio (L.E.R.) was greater than one by intercropping treatments. The yield advantage was produced and land usage was increased by intercropping safflower with broad bean.

This work was designed to study the effect of intercropping Chinese garlic with fennel, coriander or caraway plants on the growth, yield, oil content, land equivalent ratio and net profit/feddan.

MATERIALS AND METHODS

The experiment was conducted at the Experimental Farm of the Desert Development Center, American University in Cairo (DDC, AUC) in South Tahrir during the two successive seasons of 1999/2000 and 2000/2001 to study the effect of intercropping Chinese garlic with fennel, coriander or caraway plants on the growth, yield, oil content, land equivalent ratio and net profit/feddan.

The experiment included seven treatments as follows:

- 1- Pure stand (monocropping or sole crop) of Chinese garlic plants (main crop).
- 2- Pure stand (monocropping or sole crop) of fennel plants.
- 3- Pure stand (monocropping or sole crop) of coriander plants.
- 4- Pure stand (monocropping or sole crop) of caraway plants.
- 5- Intercropping Fennel with Chinese garlic on the other side of the ridge.
- 6- Intercropping Coriander with Chinese garlic on the other side of the ridge.
- 7- Intercropping caraway with Chinese garlic on the other side of the ridge.

Spacings were 10 cm for Chinese garlic and 30 cm for fennel, coriander and caraway. The plot area was 8.75 m² (2.5 x 3.5 m) containing four ridges each of 60 cm in width and 3 m in length. Each plot contained 120 plants (30/ridge) for Chinese garlic and 40 plants (10/ridge) for fennel, coriander or caraway. Complete randomized block design with three replicates was used. On 30th Sept., Chinese garlic cloves were planted, while seeds of fennel, coriander and caraway were sown on 20th Oct., and the plantation was done on one side of the ridge. Plants of each crop received the recommended agricultural practices. Chinese garlic and coriander plants were harvested on 5th and 20th April respectively, while plants of fennel, and caraway were harvested on 15th May. The following data were recorded: plant height, No. of branches & leaves/plant, fresh and dry weights/plant, No. of cloves/bulb & umbels/plant as well as clove weight and weight of 100 fruits. Also yield of bulbs & fruits, percentage and yield of oil, percentage of yield reduction, land equivalent ratio (L.E.R.) and the net profit were calculated. The volatile oil percentage was estimated according to Guenther (1961). Essential oil components were determined according to Hoftman (1967) in the Central Lab., of Agric. Fac., Cairo Univ. Land equivalent ratio (L.E.R.) was calculated according to Willy and Osiru (1972) as follows :

$$R_1 = \frac{\text{Intercropped yield of Chinese garlic (with fennel)}}{\text{Pure stand yield of Chinese garlic}}$$

$$R_2 = \frac{\text{Intercropped yield of Fennel}}{\text{Pure stand yield of Fennel}}$$

$$R_3 = \frac{\text{Intercropped yield of Chinese garlic (with coriander)}}{\text{Pure stand yield of Chinese garlic}}$$

$$R_4 = \frac{\text{Intercropped yield of Coriander}}{\text{Pure stand yield of Coriander}}$$

$$R_5 = \frac{\text{Intercropped yield of Chinese garlic (with caraway)}}{\text{Pure stand yield of Chinese garlic}}$$

$$R_6 = \frac{\text{Intercropped yield of Caraway}}{\text{Pure stand yield of Caraway}}$$

LER (for intercropping Chinese garlic with fennel) = $R_1 + R_2$

LER (for intercropping Chinese garlic with coriander) = $R_3 + R_4$

LER (for intercropping Chinese garlic with caraway) = $R_5 + R_6$

Net profit per feddan for different intercropping treatments was done based on the local price of Chinese garlic, fennel, coriander and caraway during the same plantation season to obtain the total income (total financial) per feddan .

Net profit/feddan = Total income/feddan – cost/feddan

All data were statistically analyzed according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

A- Chinese garlic

Results in Table (1) indicated that the plant height was significantly decreased by intercropping, so the pure stand treatment produced the tallest plants. The other growth parameters such as No.of both leaves/plant & cloves/bulb, fresh & dry weights/plant as well as clove weight, were also significantly decreased with intercropping treatments as compared to pure stand treatment. In addition, data cleared that growth of Chinese garlic was depressed by intercropping with fennel more than with coriander or caraway, therefore the least values of Chinese garlic growth parameters were found by intercropping with fennel. Regarding the yield of bulbs per plant or per feddan, they were significantly decreased due to the intercropping systems when compared to monocropping treatment (Table 1). When Chinese garlic intercropped with fennel, the greatest reduction in Chinese garlic yield was obtained when compared to other intercropping treatments. The percentages of reduction in Chinese garlic yield were 32.80, 14.65 and 23.76% for intercropping with fennel, coriander and caraway, respectively in the first season, while they were 36.98, 20.89 and 19.64% in the second season as shown in Table (1). Concerning the oil percentage of Chinese garlic, it is clear that different intercropping systems decreased the percentage of Chinese

garlic volatile oil as compared to sole crop treatment. Oil yield per plant was substantially decreased by intercropping. The highest oil content was found with pure stand of Chinese garlic followed by intercropping Chinese garlic with caraway, coriander and fennel respectively. The main components of the volatile oil of Chinese garlic that separated by G.L.C. and their percentage are shown in Table(1) & Fig(1). The obtained results showed that, the major components of the volatile oil of Chinese garlic were Methyl allyl disulfide and Dimethyl trisulfide. Data cleared that the main components were not substantially affected by different intercropping systems. Similar findings were obtained by Ram and Kumar (1998), they stated that the quality of geranium essential oil in terms of its major constituent, citronellol, was not affected by intercropping with garlic, onion, coriander, mustard or wild marigold. Eid and El-Gizy (1995) found that, plant growth of sunflower significantly decreased by intercropping with broad bean. Also yield of both sunflower and broad bean were significantly decreased due to intercropping.

B- Fennel

Plant height of fennel was significantly increased when intercropped with Chinese garlic, while No. of branches/plant, fresh & dry weights of plant as well as No. of umbels/plant and weight of 100 fruits were significantly reduced by intercropping (Table 2). As for the fruit yield, it can be concluded that it was decreased with intercropping treatment as compared to pure stand one. However the reduction percentages were 13.40 and 12.09% for the first and second seasons, respectively as shown in Table (2). Although the oil percentage was not affected by intercropping, the oil yield/plant was significantly decreased due to the intercropping and the highest oil content was found with sole crop. Results in Table (2) & Fig (1) represented the percentage of volatile oil constituents of fennel fruits. It is clear that the major components of fennel oil were Anethole, Limonene and Methyl chavicol. The percentages of both Anethole, and Limonene were not considerably changed, while the percentage of Methyl chavicol was slightly increased due to intercropping. These results are in accordance with those obtained by El-Gamal *et al* (1984), they concluded that onion and garlic were suitable combination as intercrops with geranium. Also, Al-Masry *et al* (1990) stated that intercropping slightly reduced herbage and oil of both dill and peppermint compared with pure stand crops. Seed oil yield of dill was slightly reduced and the oil composition of the studied crops was unaffected by intercropping.

C- Coriander

It is clear from Table (3) that intercropped Chinese garlic with coriander has a positive effect on the plant height of coriander, so the treatment of sole crop produced shorter plants than those with intercropping treatment. The opposite trend was observed for the other growth parameters which include No. of umbels / plant, fresh & dry weights of plant as well as No. of umbels/plant and weight of 100 fruits. Fruit yield produced per plant or feddan was significantly decreased by intercropping and the reduction percentages were 12.81 and 10.55% for the first and second seasons respectively as shown in Table (3).

Table (1): Effect of intercropping Chinese garlic with fennel, coriander or caraway on the growth parameters, yield and oil content of Chinese garlic during the two successive seasons of 1999/2000 and 2000/2001.

Parameters	Treatments										
	First season					L.S.D (0.05)	Second season				
	Pure Stand of Chinese garlic	Intercropping Chinese garlic with fennel	Intercropping Chinese garlic with coriander	Intercropping Chinese garlic with caraway	Pure Stand of Chinese garlic		Intercropping Chinese garlic with fennel	Intercropping Chinese garlic with coriander	Intercropping Chinese garlic with caraway	L.S.D (0.05)	
Plant height (cm)	68.00	55.16	57.08	62.82	3.80		66.62	54.05	57.30	59.00	4.29
No. of leaves/plant	10.12	7.76	7.93	8.85	0.53		10.00	7.87	8.21	8.08	0.48
Fresh weight (g/plant)	153.18	120.26	127.75	133.83	8.96		149.36	119.84	125.90	127.37	7.84
Dry weight (g/plant)	65.89	51.02	53.32	55.45	4.87		64.25	51.84	54.77	54.35	3.60
No. of cloves/bulb	13.97	12.10	12.41	12.90	1.05		13.88	12.16	12.50	12.84	N.S.
Clove weight (g)	6.98	5.41	6.71	5.76	N.S.		6.03	4.34	5.30	5.24	0.27
Oil %	0.12	0.09	0.08	0.10	0.01		0.13	0.08	0.08	0.09	0.02
Bulb yield (g/plant)	97.50	65.52	83.22	74.33	5.96		83.68	59.73	66.20	67.25	6.19
Oil yield (ml/plant)	0.117	0.059	0.067	0.074	0.028		0.109	0.042	0.053	0.061	0.021
Bulb yield (ton/feddan)	5.850	3.931	4.993	4.460	0.358		5.021	3.164	3.972	4.035	0.372
Reduction % of bulb yield	00.00	32.80	14.65	23.76	-		00.00	36.98	20.89	19.64	-
Major oil components (%): - Methyl Allyl disulfide	-	-	-	-	-		63.77	65.43	65.16	60.64	-
- Dimethyl trisulfide	-	-	-	-	-		15.81	14.37	15.15	13.42	-

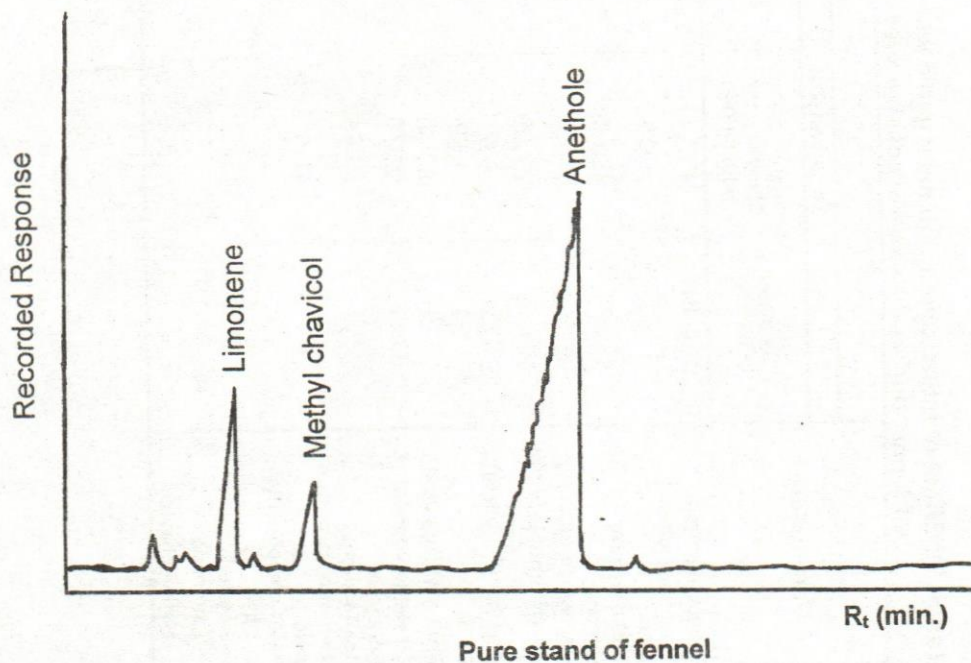
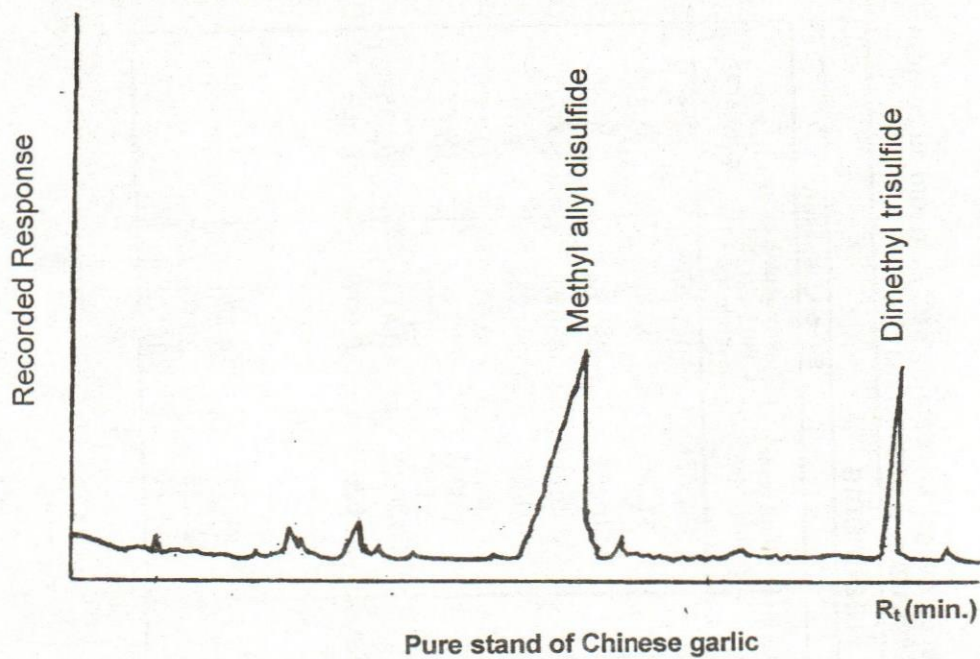


Fig. 1 : Separation of the essential oil components of Chinese garlic and fennel (G.L.C. analysis).

The percentage of coriander volatile oil was unaffected by intercropping. Oil yield of coriander was insignificantly decreased when coriander intercropped with Chinese garlic. However the highest yield of both fruits and oil were obtained with monocropping treatment. G.L.C. for oil analysis is shown in Table (3) & Fig (2). Data cleared that, Linalool represented the main component of coriander oil which was not substantially affected by intercropping system. Many workers came to the same conclusion. Haridy *et al* (1990) indicated that the yield of coriander fruits and the oil yield per plant were significantly decreased by intercropping with cabbage, lettuce or radish. El-Gamal *et al* (1988) reported that number of fruits/plant, yield of fresh and dry sepales and organic acids percentage in roselle plant were slightly decreased by intercropping with sesame. Anthocyanine content was significantly decreased due to intercropping.

D- Caraway

Data found in Table (4) revealed that intercropped Chinese garlic with caraway increased the plant height of caraway, while No.of branches & umbels/plant, weight of plant and weight of 100 fruits were significantly decreased as compared to pure stand treatment. Also, the fruit yield was significantly decreased by intercropping and the reduction percentages were 11.75 and 12.05% for the first and second seasons, respectively (Table 4). Although the oil percentage was not affected by intercropping, the oil content of caraway plant tended to decrease when intercropped with Chinese garlic. The percentage of coriander volatile oil was unaffected by intercropping. Oil yield of coriander was insignificantly decreased when coriander intercropped with Chinese garlic. However the highest yield of both fruits and oil were obtained with monocropping treatment. G.L.C. for oil analysis is shown in Table (3) & Fig (2). Data cleared that, Linalool represented the main component of coriander oil which was not substantially affected by intercropping system. Many workers came to the same conclusion. Haridy *et al* (1990) indicated that the yield of coriander fruits and the oil yield per plant were significantly decreased by intercropping with cabbage, lettuce or radish. El-Gamal *et al* (1988) reported that number of fruits/plant, yield of fresh and dry sepales and organic acids percentage in roselle plant were slightly decreased by intercropping with sesame. Anthocyanine content was significantly decreased due to intercropping.

Land equivalent ratio

Data in Table(5) show that the effect of intercropping on land equivalent ratio (LER) of Chinese garlic with fennel, coriander or caraway was greater than one, while it was less than one for monocropping of each crop. This showed that the actual productivity of the intercropping plants in the unit area of land was greater than the expected productivity of the monocropping plants in the same area of land. The obtained results indicated that intercropping Chinese garlic with coriander produced the best yield advantage and the highest land usage, followed by intercropping Chinese garlic with caraway or fennel respectively. Eid & El- Gazy (1995) found that L.E.R. of safflower and broad bean was greater than one, while it was less than one for monocropping of each plant. Also Shahien (1991) intercropped tomato with broad bean and came to the conclusion.

Table (3): Effect of intercropping Chinese garlic with coriander on the growth parameters, yield and oil content of coriander during the two successive seasons of 1999/2000 and 2000/2001.

Parameters	Treatments				
	First season		Second season		
	Pure stand of Coriander	Intercropping Chinese garlic with Coriander	L.S.D (0.05)	Pure stand of Coriander	Intercropping Chinese garlic with Coriander
Plant height(cm)	118.00	121.65	2.40	114.34	116.57
No.of branches/plant	10.61	8.33	1.30	10.13	8.67
Fresh weight (g/plant)	613.34	539.71	19.92	608.28	528.75
Dry weight (g/plant)	305.19	261.75	12.19	302.75	248.44
No. of umbels /plant	90.62	72.97	8.43	94.44	74.36
Weight of 100 fruits (g)	1.45	1.18	0.20	1.43	1.23
Oil %	0.32	0.32	N.S.	0.29	0.32
Fruit yield (g/plant)	21.08	18.38	1.94	22.28	19.93
Oil yield(ml/plant)	0.067	0.059	N.S.	0.065	0.064
Fruit yield (ton/feddan)	0.843	0.735	0.018	0.891	0.797
Reduction % of fruit yield	00.00	12.81	-	00.00	10.55
Major components of oil (%): - Linatool	-	-	-	77.83	77.05
					-

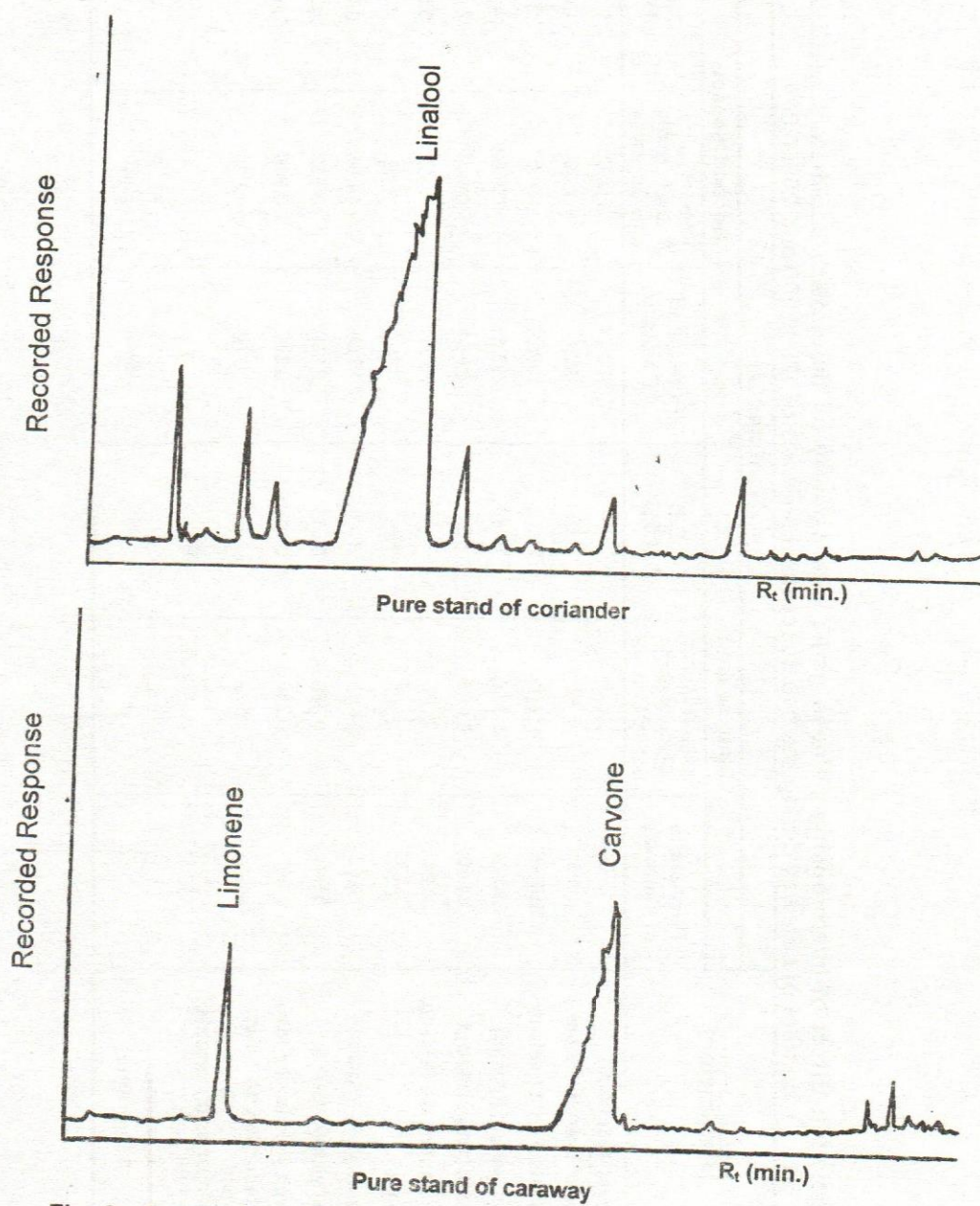


Fig. 2 : Separation of the essential oil components of coriander and caraway (G.L.C. analysis)

Table (4): Effect of intercropping Chinese garlic with caraway on the growth parameters, yield and oil content of caraway during the two successive seasons of 1999/2000 and 2000/2001.

Parameters	Treatments					
	First season			Second season		
	Pure stand of Caraway	Intercropping Chinese garlic with Caraway	L.S.D (0.05)	Pure stand of Caraway	Intercropping Chinese garlic with Caraway	L.S.D (0.05)
Plant height(cm)	111.04	115.93	2.64	108.74	112.00	1.15
No.of branches/plant	9.65	7.37	2.07	9.33	7.00	1.86
Fresh weight (g/plant)	597.46	474.12	25.13	599.24	479.87	22.92
Dry weight (g/plant)	293.64	243.05	10.56	298.51	235.82	14.50
No. of umbels /plant	84.16	61.53	5.25	81.84	61.48	7.09
Weight of 100 fruits (g)	0.94	0.79	0.11	0.91	0.78	0.09
Oil %	2.38	2.40	N.S.	2.45	2.42	N.S.
Fruit yield (g/plant)	16.60	14.65	1.11	15.98	14.05	0.72
Oil yield(ml/plant)	0.664	0.586	0.051	0.639	0.562	0.036
Fruit yield (ton/feddan)	0.395	0.352	0.019	0.392	0.340	0.034
Reduction % of fruit yield	00.00	11.75	-	00.00	12.05	-
Major components of oil (%):						
- Carvone	-	-	-	72.51	73.72	-
- Limonene	-	-	-	19.49	19.26	-

Table (5): Effect of intercropping Chinese garlic with fennel, coriander or caraway on the land equivalent ratio (L.E.R) during the two successive seasons of 1999/2000 and 2000/2001.

Parameters	Treatments					
	First season			Second season		
	Intercropping Chinese garlic with fennel	Intercropping Chinese garlic with coriander	Intercropping Chinese garlic with caraway	Intercropping Chinese garlic with fennel	Intercropping Chinese garlic with coriander	Intercropping Chinese garlic With caraway
Chinese garlic	0.672	0.854	0.762	0.630	0.791	0.804
Fennel	0.871	-	-	0.879	-	-
Coriander	-	0.872	-	-	0.895	-
Caraway	-	-	0.882	-	-	0.879
L.E.R	1.543	1.726	1.644	1.509	1.686	1.683

Economic return

Data in Table (6) showed the production, total income and net profit per feddan for different intercropping treatments. It is evident from these data that the intercropping treatments gave the higher net profit than monocropping, except in case of intercropping Chinese garlic with fennel which gave less net profit than sole crop of Chinese garlic, although it was more than the net profit of pure stand of fennel.

It could be concluded that, although intercropping Chinese garlic with either fennel, coriander or caraway plants, led to slight reduction in the growth and yield parameters of the species under investigation, the net return of the unit cultivated area was higher in case of intercropping in comparison with monocropping. Intercropping Chinese garlic with coriander is recommended to obtain the highest value of land equivalent and land usage. The intercropping didn't affect the oil quality of these species.

Table (6) : Effect of intercropping Chinese garlic with fennel, coriander or caraway on the monetary return per feddan during the two successive seasons of 1999/2000 and 2000/2001.

Treatments	Parameters									
	Production (ton/feddan)					Total income (L.E)				
	Chinese garlic	Fennel	Coriander	Caraway	Chinese garlic	Fennel	Coriander	Caraway	Total	Net profit (L.E.)
First season										
Pure stand of Chinese garlic	5.850	-	-	-	-	-	-	-	4972.5	2472.5
Pure stand of fennel	-	0.940	-	-	-	1880.0	-	-	1880.0	980.0
Pure stand of coriander	-	-	0.843	-	-	-	1475.3	-	1475.3	575.3
Pure stand of caraway	-	-	-	0.664	-	-	-	2324.0	2324.0	1424.0
Intercropping Chinese garlic with fennel	3.931	0.814	-	-	3341.4	1628.0	-	-	4969.4	1969.4
Intercropping Chinese garlic with coriander	4.993	-	0.735	-	4244.1	-	1286.3	-	5530.4	2530.4
Intercropping Chinese garlic with caraway	4.460	-	-	0.586	3791.0	-	-	2051.0	5842.0	2842.0
Second season										
Pure stand of Chinese garlic	5.021	-	-	-	-	-	-	-	4267.9	1767.9
Pure stand of fennel	-	1.026	-	-	-	2052.0	-	-	2052.0	1152.0
Pure stand of coriander	-	-	0.891	-	-	-	1559.3	-	1559.3	659.3
Pure stand of caraway	-	-	-	0.639	-	-	-	2236.5	2236.5	1336.5
Intercropping Chinese garlic with fennel	3.164	0.902	-	-	2689.4	1804.0	-	-	4493.4	1493.4
Intercropping Chinese garlic with coriander	3.972	-	0.797	-	3376.2	-	1394.8	-	4771.0	1771.0
Intercropping Chinese garlic with caraway	4.035	-	-	0.562	3429.8	-	-	1967.0	5396.8	2396.8

REFERENCES

- Al-Masry, M.H.; A.A. El-Bedaway and S.M. El-Deeb (1990). Yield and quality of seed and herb oil of dill as intercrop of peppermint grown under sprinkler system of irrigation. *Minofiya J. Agric. Res.*, 15 (2): 516-531.
- Augusti, K.T. (1977). Hypocholesterolamic effect of garlic. *Ind. J. Exp. Biol.* 15: 489.
- Brahmachari, H.D. and K.T. Augusti (1962). Orally effective hypoglycaemic agent. *J. Pharm. and Pharmacol.* 14, 254.
- Eid, M.I. and S.M. El-Gizy (1995). Effect of intercropping safflower with broad bean on plant growth and yield. *Minofiya J. Agric. Res.*, 20 (4): 1611-1625.
- El-Gamal, E.H.; K.A. Awaad and M.Th. Soliman (1984). Intercropping and its effects on geranium yield and herb. 1st Arab Conf. for Med. Plants, Nov. 1984, Cairo, Egypt.
- El-Gamal, E.H.; M.R. Khater and K.A. Awaad (1988). Study on the intercropping between roselle and sesame. *J. Agric. Sci. Mansoura Univ.*, 13 (4): 2302-2306.
- Guenther, E. (1961). *The Essential Oils*. D. Van Norstrand Co., Inc., Canada, Vol. III, 4th Ed., pp. 399-433.
- Haq, Z.U.; S.H. Saddozai; H.M. Jahanzeb and M.S. Zia-Ullah (1997). Economics of intercropping: a case study of tomato production in garlic in district Nowshera. *Sarhad J. Agric.*, 134 (2): 199-206.
- Haridy, I.M.A.; A.H. El-Zahwey and H.H. Shaheen (1990). Effect of intercropping coriander and some vegetable crops. *Minofiya J. Agric. Res.*, 15 (2): 532-550.
- Hoftman, E. (1967). *Chromatography*. Reinhold Publ. Corp., 2nd ed., pp. 208-515.
- Lio, G. and R. Agnolia (1927). Action of *Allium sativum* on smooth muscle. *Arch. Intern. Pharmacodynamic*, 33: 400.
- Ram M. and S. Kumar (1998). Intercropping medicinal, sepiace and oil seed crops with geranium for improving productivity in assured input system of a subtropical environment. *J. of Medicinal and Aromatic plant Sciences*. 20 (4): 1060-1066.
- Naganathan, T.G.; R. Arumugam; M. Kulasekaran and S. Vadivelu (1988). Effect of antagonistic crops as intercrop on the control of nematodes. *Ind. J. Agron.*, 33 (4): 432-440.
- Nikam, S.M.; M.S. Mahajan and A.B. Deokar (1988). Improvement of monetary return of coriander through safflower intercropping in dry land. *Indian Journal of Agricultural Sciences*. 1988, 58:3, 202-205.
- Shahien, A.H.M. (1991). Effect of inter and intra specific competition between tomato and some leguminous. Ph.D. Thesis, Fac., Cairo Univ.
- Singh, S.N.; J.P. Shukla; M.L. Agrawal and G.P. Singh (1999). Spices intercropping with autumn planted sugarcane. *Ind. J. Agron.*, 44 (1): 64-76.
- Snedecor, G.W. and W.G. Cochran (1980). *Statistical Methods*, 7th ed. Iowa State Univ. Press, Ames, Iowa, U.S.A.

- Varun, C.L.; S. Singh and H.N. Singh (1990). Effect of intercropping spices on the incidence of top borer in sugarcane under bhat soil condition. Indian Sugar, 39 (10): 751-756.
- Velasquez, B.L.; P.S. Garcin, C.D. Mijan and A.C. Hernnand (1958). Vascular effect of garlic extract. It's mechanism of action. Arch. Inst. Farma., 10 (5): 670-682.
- Willy, R.W. and Osiru, S.O. (1972). Studies on mixtures of maize and beans *Phaseolus vulgaris* with particular reference to plant population. J. Agric. Sci., Cambridge, 79: 519.

تحميل الثوم الصينى على كل من نباتات الشمر و الكزبرة و الكراوية

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القاهرة

فى تجربة حقلية أجريت فى المزرعة البحثية بمركز تنمية الصحراء بجنوب التحرير التابعة للجامعة الأمريكية خلال موسمى ٢٠٠٠/١٩٩٩ ، ٢٠٠١/٢٠٠٠ وذلك لدراسة تأثير تحميل الثوم الصينى على كل من نباتات الشمر و الكزبرة و الكراوية على النمو والمحصول ومحتوى الزيت ونسبة المكافىء الأرضى والعائد الإقتصادى. وقد أظهرت النتائج أن نمو النبات (عدد الفروع والأوراق والنورات للنبات - الوزن الطازج والجاف للنبات - عدد الفصوص فى البصلة - وزن الفص - وزن ١٠٠ ثمرة) إنخفض معنويا فى النباتات المحملة بينما زادت قليلا صفة طول النبات فى كل من الشمر والكزبرة والكراوية. وأدى التحميل إلى حدوث نقص معنوى فى المحصول لجميع النباتات وذلك بالمقارنة مع غير المحمل وعلى العكس وجد أن جميع معاملات التحميل أدت إلى زيادة فى إنتاجية الفدان بالمقارنة بالغير محمل الا فى معاملة تحميل الثوم الصينى مع الشمر فإن العائد المادى كان أقل من زراعة الثوم الصينى بدون تحميل. وقد أدى التحميل إلى نقص نسبة الزيت الطيار فى الثوم الصينى بينما لم تتأثر فى كل من الشمر و الكزبرة و الكراوية. لم تتأثر المركبات الرئيسية للزيت الطيار فى كل من النباتات تحت الدراسة بمعاملات التحميل. كما أدى التحميل إلى زيادة قيمة نسبة المكافىء الأرضى عن واحد. وكانت أفضل المعاملات هى تحميل الثوم الصينى على الكزبرة يليها الكراوية ثم الشمر. وينصح بتحميل الثوم الصينى مع الكزبرة للحصول على أقصى قيمة لنسبة المكافىء الأرضى وأكبر إستفادة من الأرض .