

EFFECT OF PLANTING DISTANCES ON FLOWERING AND ACTIVE INGREDIENTS OF *CHRYSANTHEMUM CINERARIAEFOLIUM* VIS.

SHADIA KOTB AHMED AND MAHMOUD HAMDY ABU ZEID

Horticultural Research Institute, Agricultural Research Centre. Giza, Egypt.

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Abstract

A field experiment was conducted at the Farm of Medicinal and Aromatic plants Section, Dokki during two seasons 1995 and 1996 to study the effect of different planting distances (40, 50, and 60 cm) on the number of flowers, fresh and dry weights as well as their content in different picks and also in different stages of flower buds development.

The results showed that, the number of flowers, fresh and dry weights per plant significantly increased by increasing the distance between plants. Also the fresh and dry weights per plot significantly increased by increasing distances between plants up to 50cm. The data also showed that during the growing season, seven picks were taken from the plants, and the number of flowers, fresh and dry weights per plant and per plot increased steadily up to fourth and fifth pick, and then they decreased. The data however showed an opposite effect of planting distances on the fresh and dry weights per plot i.e. the distance 50 cm gave the highest weights.

As for pyrethrin content and its yield the data showed generally that the planting distance 50 cm gave the highest content and yield of pyrethrin I. The data showed that there were seven stages of flower bud development and that the pyrethrin I content increased gradually until it reached the seventh stage, which is the best stage for picking the flower.

Therefore, it could be recommended to plant pyrethrum plant at 50 cm distances and to pick the flower at the seventh stage, i.e. the flower is well developed and full expanded and the white ray flowers are horizontal and parallel to the surface of the soil. This is the best stage for picking the flowers.

INTRODUCTION

Nowadays there is an increasing demand for the use of natural products, instead of synthetic ones to be used as domestic insecticides. This, encouraged

investigators to carry out studies leading to increase the production and improve the quality of pyrethrum plants.

Pyrethrum flowers are more or less fully expanded flower heads of *chrysanthemum cinerariaefolium*. L family compositeae. Pyrethrum flowers contain about 1-2% of two groups of esters, known as pyrethrin I and pyrethrin II. These esters are compounds of several related Ketoalcohols compound with chrysanthemic acid. The esters pyrethrin I and II are the active constituents of pyrethrum flowers which have the insecticidal properties, he also added that powdered pyrethrum flowers, sometimes mixed with synthetic products, is widely used as an insecticide the bulk of the production, is widely used as an insecticide. The bulk of the production, however, is employed for making extracts in Kerosene or other solvents, which are diluted and used in sprays against a large variety of pests such as house-flies and others affecting stock and insects in stored products).

He added that, pyrethrum is remarkable for the almost instantaneous (knockdown) of the sprayed insects. It is harmless to warmblooded animals. The rate of knockdown of blowflies is used as a biological measure of its insecticidal activity. Certain chemical substances have been found to increase the insecticidal potency of pyrethrum (Wallis 1960).

The most effective powder is that of which 80 per cent will pass through a number 280 standard mesh sieve pyrethrum extracts and pyrethrins are noted for their quick" knowckdown of flying insects, particularly flies and mosquitoes (claus 1961).

Several works had been done in Egypt about the effect of cultural practices on many Chrysanth species. However a lack of information have been noticed regarding the effects of such practices (i.e) planting distances on *Chrysanthemum cinerariaefolium*.

Lepiece (1974) on pyrethrum *Chrysanthemum cinerariaefolium*, which cultivated in Rwanda found that, the plants which were spaced at 60 x 40 cm gave the highest yield flower than 60 x 35 cm and 60 x 30 cm.

Peneva (1969), study 6 spacing tested in 4-year trials the highest yields both of flowers and pyrethrins were obtained at 70 x 30 cm, followed by 60* and 70* cm. The inter-row distance of 70 cm was better than 60 cm both for light reception and for mechanization. Grown on poor soils without irrigation and with moderate

-fertilization in Bulgarian.

Hocomb and Mastalez 1979 working on *Chrysanthemum* found that fresh weight and flower diameter decreased with reduced spacing between the plants.

Jaswinder and Arora from plants cultivated at 1980 found that when *Tagetes erecta* L. Plants were spaced at 40 x 30, 40 x 40 or 40 x 50 cm, the flower yield per plant was greatest at the wide spacing.

Farina and paterniani 1986 on single bloom chrysanthemum found that when yellow tuner was planted in a field plot at 12, 15 or 18 plants m² blooms weight and diameter fell with increasing plant density.

Sastry et al. 1989 on *Chrysanthemum cinerariaefolium* vis. indicated that plant spacing of 60 x 45 cm gave higher yield than different combinations of 30, 45 and 60 cm as inter and intra-row spacing the high yield was attributed to both increased number of flower plants and dry matter production efficiency.

MATERIALS AND METHODS

Field experiment was done to study the effect of planting distances on the flowering production and active constituents of *Chrysanthemum cinerariaefolium*. Vis.

This study was performed at the Farm of Medicinal and Aromatic plants section, Dokki, Egypt during two seasons 1995 and 1996.

Seedlings were obtained from the Farm of Medicinal and Aromatic Plants Section of El-Kanater and planted in February 16th in the two mentioned seasons (1995 and 1996).

Seedlings were transplanted on rows 60 cm apart. The experiment area was 2 x 3 m². Three distances were used 40, 50 and 60 cm. These led to number of plants 28, 24 and 20 respectively in the experimental plots. The experiment was designed in complete randomized blocks with three replicates.

NPK fertilization were added as follows:

(4.2, 2.8 and 0.7 kg.) Amonium Sulfate (20.6% N), Calcium Superphosphate (16% p₂O₅) and Potassium Sulfate (48% k₂O) respectively for the experimental

area every season, the half batch was added after one month from planting and the other half was added at the beginning of flowering. All the agricultural practices were done to the plant.

Seven picks were taken every season at seven day intervals starting May 1st and ending June 19th.

The following data were recorded for every pick: number of flowers per plant, fresh and dry weights of flowers per plant as well as per plot, pyrethrin I in dry flowers in different picks and in different stages of flower development but also were recorded.

The stepwise of development of flower:-

- 1- Closed flower bud.
- 2- Bud initiation (2 days from the first stage)
- 3- Starting of opening the flower bud (4 days from the first stage).
- 4- Growing of disc florets and increasing of the bud size (5 days from the first stage).
- 5- White ray flower had inclined direction (6 days from the closed one)
- 6- The fifth stage continued with increasing in inclination of ray flower (7 days from the closed one).
- 7- The flower became horizontal with respect to surface of the soil and is ready to be picked.

Pyrethrin I in dried flowers was estimated according to the method described by Egyptian pharmacopoeia 1960 as follows:

Introduce 10 gm. of powdered Pyrethrum Flower, module No. 22, accurately weighed, into a flask, add 50cc. of petroleum-benzene R., shake well, set aside for 15 minutes, and shake frequently for 1 hour. Transfer the mixture to a small continuous extraction apparatus, plugged with cotton-wool, and when the liquid ceases to flow pack firmly, and continue the extraction, until complete exhaustion of the drug is effected. Filter the extract through a dry filter paper into a flask, and wash the receiver and filter with a little petroleum-benzene R., adding the washings to the

content of the flask. Add 5cc. of N/L sodium hydroxide in methyl alcohol R., connect the flask with a reflux condenser, and heat on a water-bath of 2 hours. cool, acidify with NL sulfuric acid, and distill in a current of steam, until 150 cc. of the aqueous distillate are collected below the petroleum-benzene layer in the receiver. Transfer both liquids to a separator, then added 10 gm. of sodium chloride, and shake vigorously. After separation, run off the aqueous layer into a second separator and shake with successive portions, each of 20cc. of petroleum-benzene. R., Mix the petroleum-benzene extracts, and wash with 3 successive portions each of 10 cc. of water. Transfer the petroleum-benzene extracts to a stoppered bottle, and rinse the separator successively with 10 cc. of neutral alcohol and 20 cc. of water adding the rinsing to the bottle. Add 3 drops of phenolphthalein T.S, and titrate with N/50 sodium hydroxide, until aqueous layer shows a distinct red coloration after vigorous shaking in the stoppered-bottle for at least a minute. Carry out a blank test in exactly the same manner, but without the Pyrethrum Flower. The difference between the two titrations represents the amount of N/50 sodium hydroxide used. Each cc. of N/50 sodium hydroxide is equivalent to 0.00663 gm. of Pyrethrin I. Storage in well-closed containers, in a cool dry place, protected from light.

The obtained data were subjected to the statistical analysis according to sie-decor (1972) using L.S.D.

Table 1. The analyses of the soil during 1995 and 1996 seasons.

season	T.S.S	PH 1:2.5	E.C mmoh/cm	Anion meq/100 gm soil				cation meq/100 gm soil				ppm		FC
				co3	H co3	cl	So4	ca	Mg	Na+	K+	N+	P+	
1 st	0.102	7.4	0.32	-	1.22	0.38	0.23	0.65	0.42	0.64	0.12	70.98	3.3	31.34
2 nd	0.120	7.3	0.39	-	0.76	0.20	1.09	0.67	0.55	0.68	0.15	124.22	4.6	31.29

RESULTS AND DISCUSSION

1- Effect of planting distances on flowering :

1.1- Number of flowers :

Data in table 2 showed that, number of flowers per plant, significantly increased when distance between the plants increased. Comparing the distances (40, 50, and 60 cm) the results showed that there were significant increases between distances. These results were observed in both seasons .

Table 2. Effect of planting distances on number of flowers during different picks *Chrysanthemum cinerariaefolium* in 1995 and 1996.

Pick	1st Pick		2nd Pick		3rd Pick		4th Pick		5th Pick		6th Pick		7th Pick	
	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season
Planting distances														
40	8	6	13.3	7.9	10.7	10.6	12	14.6	13.3	13.6	7.7	8	3.7	6.3
50	12	9.6	11	12	16	16.6	16.3	14.6	18	17.3	12	12.3	5	9
60	13.3	13.6	14	14	18	25.3	24	18	23.3	21	16.7	17.6	7.3	14
L.S.D. at 5%	3.06	2.61	N.S	2.29	2.04	2.61	1.25	2.04	5.51	1.31	4.46	2.08	1.91	2.08

Table 3. Effect of planting distances on flowers fresh weight (g m/plant) during different picks *Chrysanthemum cinerariaefolium* in 1995 and 1996.

Pick	1st Pick		2nd Pick		3rd Pick		4th Pick		5th Pick		6th Pick		7th Pick	
	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season
Planting distances														
40	2.4	1.8	3	2.1	3.2	3.2	3.6	3.4	3.6	4.1	2.3	2.4	1.1	1.9
50	3.4	2.9	3.3	3.6	4.8	5	4.9	4.2	5.4	5.2	3.4	3.7	1.5	2.7
60	4	4.1	4.2	4.2	5.4	7.7	6.8	5.4	7	6.3	5	5.3	2.2	3.2
L.S.D. at 5%	0.72	0.79	0.79	0.24	0.61	0.79	0.61	0.61	1.23	0.4	1.21	0.65	0.56	0.65

These results might be due to the fact that light intensity is a limiting factor to the plant growth and increasing the plant population by reducing the distances between plants decreased the light intensity. This made competition between the plant for getting more light.

The data also showed that during the growing season seven picks were obtained from pyrethrum plant, number of flowers per plant increased gradually until fourth and fifth picks when they start to decrease.

This result was in agreement with those obtained by Saleh (1982) on *Ocimum basilicum* L who found that the number of flowers increased constantly by increasing the distance between plants.

Recently Shalaby (1994) on *Chrysanthemum frutescens* L plants found that at different distances i.e. (50 x 50 cm), (75x75 cm) and (100 x 100cm) that were significant increases of flower numbers, with the increase of distance between the plants.

1-2- Fresh and dry weights of flower per plant :

From the data in table 3 and 4 it can be noticed that fresh and dry weights per plant significantly increased as planting distances were increased.

The data also showed that fresh and dry weights of flower increased steadily and reached its maximum during the fourth and the fifth picks then a drop in weights took place at the sixth and seventh picks.

These results were observed in both seasons. This increase of the fresh and dry weights of flower by increasing the distance between plants may be due to the fact that wide spacing would give more space for roots and more nutrients and light that resulted in more accumulation of nutrients in plants.

The increase of the dry weight of plant at wide spaces may be due to the increase of both fresh weight of plant and dry matter content in different parts of plants.

Similar results on the effect of plant spacing on dry weight were stated by Radwan (1988) on *Tageus erecta* L. and El sharkawy (1976) on *Majorama hortensis* L., they found that the wider space between plants gave highest yield of fresh and dry weights of flower per plant.

Table 4. Effect of planting distances on number of flowers during dry weight (gm./plant) during different picks *Chrysanthemum cinerariaefolium* in 1995 and 1996.

Pick	1st Pick		2nd Pick		3rd Pick		4th Pick		5th Pick		6th Pick		7th Pick	
	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season
Planting distances														
40	0.75	0.56	0.94	0.41	1	1	1.1	0.89	1.09	1.27	0.65	0.76	0.35	0.59
50	1.05	0.91	1.11	1.11	1.5	1.57	1.53	1.3	1.7	1.63	1.02	1.14	0.47	0.84
60	1.23	1.27	1.3	1.3	1.7	2.4	2.13	1.7	2.2	1.97	1.57	1.67	0.69	0.83
L.S.D. at 5%	0.03	--	--	--	0.23	0.23	0.23	0.43	0.43	0.07	0.4	0.16	0.23	--

Table 5. Effect of planting distances on flowers fresh weight (g m/pland) during different picks *Chrysanthemum cinerariaefolium* in 1995 and 1996.

Pick	1st Pick		2nd Pick		3rd Pick		4th Pick		5th Pick		6th Pick		7th Pick	
	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season
Planting distances														
40	67.2	50.4	84	58.8	89.6	89.6	100.8	95.2	95.3	114.8	68.1	100.5	30.8	53.2
50	81.6	69.9	79.2	86.4	114.4	120	117.6	106	124.8	124.8	81.6	88.8	36	64.8
60	79.4	82	84	84	108	154	137.3	108	140	126	100	106	44	64
L.S.D. at 5%	--	17.99	--	15.88	12.93	17.32	11.22	--	18.89	12.99	--	--	--	--

I-3 Fresh and dry weights of flowers per plot :

It was obvious from tables 5 and 6 that fresh and dry weights of flowers per plot are affected by planting distance. When plants are grown at wide space (40 and 50 cm), fresh and dry weights of flowers increased. These increase were only significant at third, fourth and fifth picks, then they decreased at sixth and seventh picks.

These results are in harmony with those obtained by Shalaby (1994) on *Chrysanthemum frutescens* L. who found that the wide space (100 x 100 cm) gave significant increase of fresh and dry weight .

II- Effect of planting distances on pyrethrin I content :

Regarding to the effect of planting distances on active principle (pyrethrin I) of pyrethrum plant, data presented in table 7 and fig. 1 showed that in most cases there were significant differences between treatments i.e. 40 , 50 and 60 cm. between plants.

In addition the data also showed that when plants were spaced at 50 cm it gave the highest content of pyrethrin I than at 40 and 60 cm.

During seven pick the pyrethrin I content increased gradually at fourth and fifth picks then drop happened at sixth and seventh picks.

II- Yield of pyrethrin I per plant :

The yield of pyrethrin I per plant were calculated mathematically by multiplying pyrethrin content mg/gm powdered pyrethrum flower and dry weights of flower per plant.

Data presented in table 8 showed that by increasing the distances between plants the yield of pyrethrin significantly increased up to 50 cm however at 60 cm, this yields were significantly decreased.

Pyrethrin I content (mg/gm) during the development of flower bud :

Data presented in fig 2 showed that there were seven stages of flower bud, and the seventh stage was the best stage for picking the flower. The content of pyrethrin I was increased steadily and reached its maximum at seventh picks.

Table 6. Effect of planting distances on flowers dry weight (gm/plant) during different picks *Chrysanthemum cinerariaefolium* in 1995 and 1996.

Pick	1st Pick		2nd Pick		3rd Pick		4th Pick		5th Pick		6th Pick		7th Pick	
	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season
Planting distances														
40	21	18.8	26.3	15	28	28	31.5	29.7	29.8	35.9	21.3	31.4	9.6	16.6
50	24.6	24.8	24.8	27	35.7	37.5	39.4	33.1	39	38.6	25.5	27.8	11.3	20.2
60	24.8	25.6	26.3	26	33.8	48.1	42.9	33.7	43.8	39.4	31.2	33.2	13.7	20.1
L.S.D. at 5%	--	--	--	1.91	3.89	5.51	2.89	--	5.92	2.43	--	--	--	--

Table 7. Effect of planting distances on pyrethrin I content % during different picks *Chrysanthemum cinerariaefolium* in 1995 and 1996.

Pick	1st Pick		2nd Pick		3rd Pick		4th Pick		5th Pick		6th Pick		7th Pick	
	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season
Planting distances														
40	0.87	1	1	1.1	0.97	1.07	1.3	1.4	1.5	1.5	1.2	1.3	0.97	0.9
50	1.23	1.53	1.2	1.3	2.2	2.27	2.2	2.2	2.3	2.43	2.1	2	1.1	1.3
60	1	1.33	1.23	1.3	2.2	2.03	2	1.9	2.11	2.06	1.8	1.87	1.03	1.2
L.S.D. at 5%	0.23	0.4	N.S	N.S	0.15	0.51	0.56	0.32	0.32	0.42	0.21	0.18	N.S	N.S

Table 8. Effect of planting distances on yield of pyrethrin I (gm) during different picks *Chrysanthemum cinerariaefolium* in 1995 and 1996.

Pick	1st Pick		2nd Pick		3rd Pick		4th Pick		5th Pick		6th Pick		7th Pick	
	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season	1 St Season	2 nd Season
Planting distances														
40	18.2	18.7	26.2	16.7	26.97	29.87	40.87	41.9	43.6	53.77	25.47	33.87	9.37	15.23
50	30.5	38.2	28.8	35	78.53	84.97	75.03	75.4	84.87	94.07	52.63	53.93	12.53	26.27
60	24.6	34.1	32.33	34.03	73.83	97.4	84.4	64.03	93.73	78.47	56.03	61.87	14.17	24.37
L.S.D. at 5%	N.S	13.6	3.3	10.4	N.S	12.8	15.7	17.7	20.6	N.S	12.1	5.6	3.5	N.S

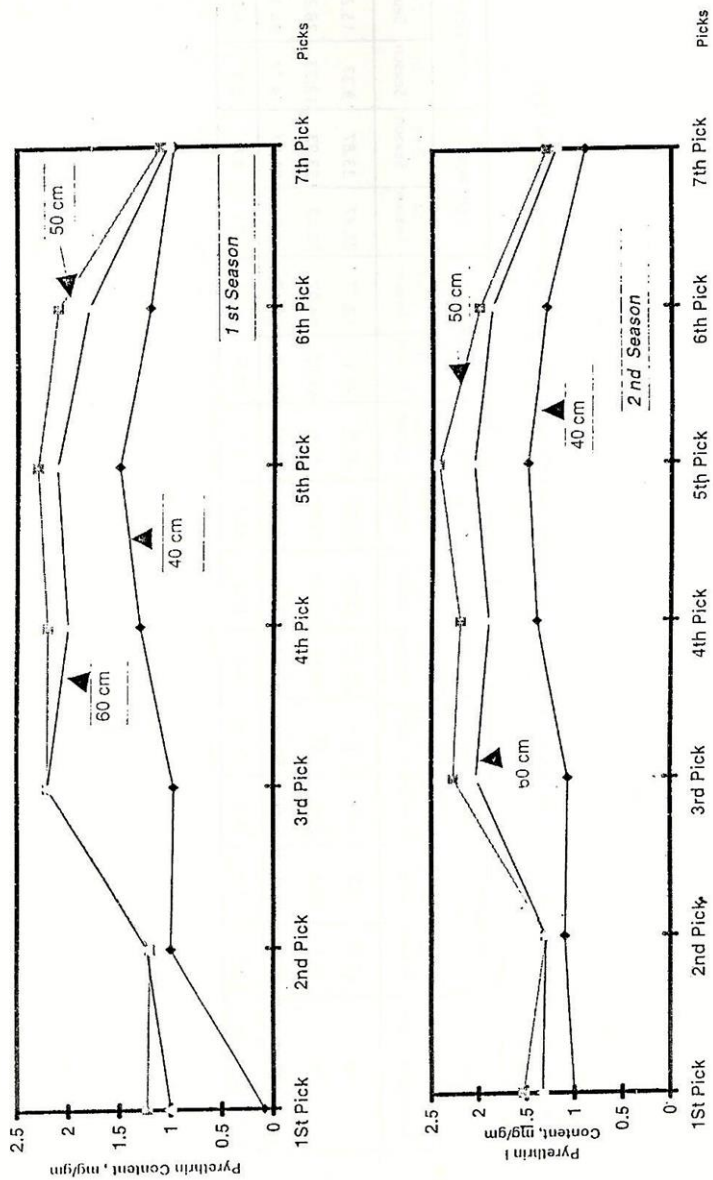
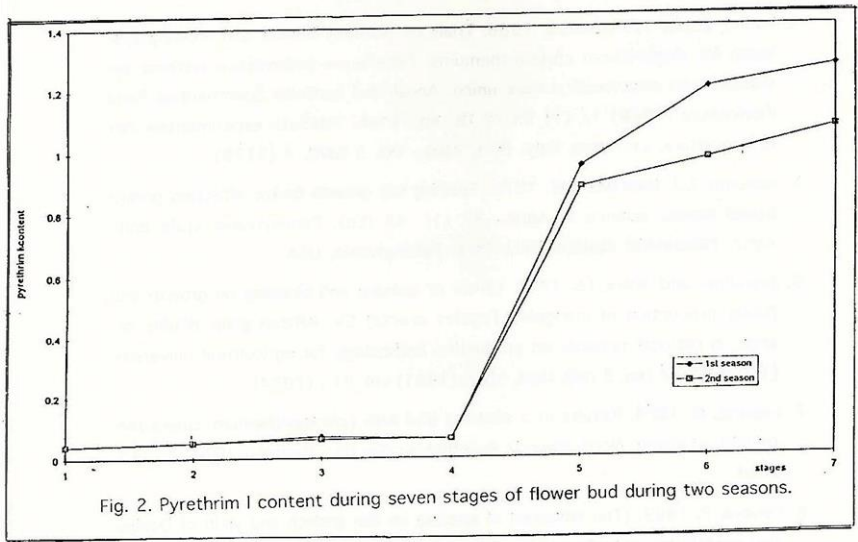


Fig. 1 Effect of planting distance on Pyrethrina Content (mg/g) during 1st and 2nd seasons.

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تأثير مسافات الزراعة على الأزهار والمادة الفعالة لنبات البيرثرم *Chrysanthemum cinerariaefolium*

شادية قطب أحمد ، محمود حمدي أبو زيد

معهد بحوث البساتين مركز البحوث الزراعية - الجيزة - مصر .

أصبحت الحاجة ملحة الى العودة الى الطبيعة ومحاولة إستخدام النباتات الطبية فى أغراض مختلفة ونظرا لما تحدثه المبيدات من آثار ضارة باقية تنتقل من محصول إلى آخر كان لابد من عمل دراسات مستفيضة على بعض النباتات المبيدة للأفات ومنها نبات البيرثرم وهذا البحث يهدف الى دراسة تأثير مسافات الزراعة كاحدى العمليات الزراعية الهامة على عدد الأزهار والوزن الطازج والجاف للأزهار ومحتواها من البيرثرين ا .

أجرى هذا البحث فى سنتين متتاليتين ١٩٩٥ / ١٩٩٦ فى مزرعة قسم بحوث النباتات الطبية والعطرية بالدقى فى تجربة لدراسة تأثير ثلاث مسافات زراعة وهى (٤٠ - ٥٠ - ٦٠سم) على التزهير والمادة الفعالة.

وقد توصلت الباحثه الى النتائج الآتية :

- ١ - تم الحصول على سبع قطفات خلال الموسم.
- ٢ - زادت عدد الأزهار زيادة معنوية بزيادة مسافة الزراعة.
- ٣ - زاد الوزن الطازج والجاف للأزهار / للنبات بزيادة مسافة الزراعة تحت الدراسة.
- ٤ - بالنسبة للقطفة التجريبية فقد وجد أنه بزيادة مسافة الزراعة حتى ٥٠ زاد الوزن الطازج والجاف للأزهار زيادة معنوية
- ٥ - من ناحية محتوى الأزهار من البيرثرين ا وكذلك المحصول فقد وجدت أن مسافة الزراعة ٥٠ سم أعطت زيادة معنوية بالمقارنة تتناقص بعد ذلك فى القيم.
- ٧ - بدراسة تطور البرعم الزهرى فنقد وجد أن المادة الفعالة وهى البيرثرين ا تزداد بالتدرج وتوصلت إلى اعلى قيمة عن المرحلة السابقة وهى وصول الزهرة الى مرحلة النضج الصالحة للقطف وتكون الأزهار الشعاعية البيضاء موازية لسطح التربة.
- ٨ - ننصح بزراعة نبات البيرثرم على مسافة ٥٠ سم للحصول على عدد أزهار ووزن طازج وجاف ومحصول مادة فعالة وكذلك يتم قطف الأزهار عند إكتمال النضج وتكون الأزهار الشعاعية موازية لسطح التربة.