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CULTIVATION OF *Melissa officinalis* ,L IN THE NORTH MIDDLE NILE DELTA REGION:
A. EFFECT OF PLANTING AND HARVESTING DATES

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ABSTRACT

Two field experiments carried out at Sakha Agricultural Research Station during the two seasons of 2008/2009 and 2009/2010 to study the effect of planting and harvesting dates on the growth ,yield and oil component of *Melissa officinalis* ,L .Two planting date , spring cultivation (11th March) and autumn cultivation (24th October) in the two seasons and two harvesting date 1- spring cultivation, the first harvest was done in the middle of July and the second in the third week of October 2- autumn cultivation, the first harvest was done in the middle of June and the second in the first week of October in the two seasons .The obtained results showed that the favorable planting date in kafr El-sheikh Governorate is spring planting which produced significantly the highest plants, more branches ,increased leaf area , the heaviest weights of fresh and dry /plant and dry yield /fed, maximum chlorophyll a, b and total chlorophyll , increasing N,P and K% , oil % and oil yield/plant and /fed. Concerning essential oil constituents geranial (citral A) were the major component of spring oil followed by camphene .Meanwhile, neral (citral B) was the major component of autumn oil , followed by geranial (citral A).The second harvesting time gave better results in most parameters than the first harvesting time .From the obvious results we can conclusion to cultivate *Melissa officinalis,*L in the spring and harvesting it after 219 day (Time of flowering).

Keywords: *Melissa officinalis* ,L , planting date , harvesting date, essential oil, oil yield.

INTRODUCTION

Lemon balm, *Melissa officinalis* L., a perennial herb native to southern climates of Europe and North America, is presently found in both wild and cultivated states. Several other species of Melissa have been reported from the Mediterranean and central Asian areas, but only *Melissa officinalis* L. is cultivated. The plant grows erect and reaches a height of 0.5 to 1 m. The highest levels of essential oil have been extracted in late summer from the lower parts of the plants (Kennedy *et al*., 2006). Lemon balm has been traditionally used for different medical purposes as tonic, antispasmodic, carminative, diaphoretic, surgical dressing for wounds, sedative-hypnotic strengthening the memory, and relief of stress induced headache as a mild sedative-hypnotic, and as an antiviral to improve healing of herpes simplex cold sores (Blumenthal *et al* ., 2000).

Medicinal plant production is mainly dependent on ecological conditions .Meanwhile, planting and harvesting date are two of the most important limiting factors that influence on plant growth and production. Selection of suitable sowing date has advantages in relation to assembling the raw material and other productions. It can be accomplished by choosing the right plant species, soil, sowing date, plant nutrition, harvest etc. In this respect, monitoring and management of environmental parameters is very

critical. The early sowing date enhanced the growth characters for various plants, such as Hadj SeyedHadi *et al*., 2004 and Mohammad *et al* (2010)on *Matricaria chamomilla*, L, Marcum and Hanson (2005) on peppermint and Khalid and Ahmed (2010) on lemon balm (*Melissa officinalis* ,L). But, the late sowing date is more favorable for promoting the constituents of other plants i.e. Selim *et al*,(1992) on *Hibiscus sabdariffa* and Omidbaigi and Mastro,2004 on *Fagopysum esculentum*. Meanwhile, Meawad *et al*,(2000) on *Hyoscyamus muticus* revealed that middle sowing date at February 15th resulted in the highest values of vegetative growth and root system characters as well as total alkaloid, yield/plant and per feddan and minerals content.

Medicinal and aromatic plants can play an important role in commercial crops, which represent significant sources of both economic revenue and earning foreign currency. Recently, an increasing interest in the production of medicinal and aromatic plants has been noticed in Egypt to cover the increasing demands of the local industries as well as export purposes. However, medicinal plants like *Melissa officinalis* plants represent safe alternative for chemical pharmaceutical industries. There is no information about the cultivation and production of *Melissa officinalis* plants in North Middle Nile Delta Region, therefore, the present study is considered as one of the first steps towards planning high productivity strategy for this plant in this region. However, select the favorable planting and harvesting date and their effect on the growth, yield and oil constituents of Lemon balm, (*Melissa officinalis* ,L) cultivation in North Middle Nile Delta Region (Kafr El-sheikh Governorate) have been reviewed

MATERIALS AND METHODS

This investigation was conducted at the Experimental Farm of Sakha Agricultural Research Station, Kafr El-Sheikh Governorate. The site is located at 30 56 N latitude, 31 05 E longitude with an elevation of about 6 meters above mean sea level. This location is a representative of conditions in the middle northern part of Nile Delta region during the two successive seasons of 2008/2009 and 2009/2010 to study the effect of planting and harvesting dates on the growth, yield and oil components of *Melissa officinalis* ,L. Melissa plantlets ,originated from stem cuttings were obtained from Medicinal and Aromatic Plants Department, ARC, Egypt and were transplanted in either Spring (11th March) or Autumn (24th October) in the two seasons . The stem cuttings were cultivated in hills of 30 cm distances, on rows 60 cm apart in plots of 6m^2 (2 x 3) as the area of each planting date treatment. The physical and chemical properties of the experimental soil were determined before cultivation, according to Jackson ,(1967),as showed in Table (A)

Meteorological conditions

Meteorological conditions during the two experimental seasons (2008/2009) and (2009/2010) for Sakha area presented in Table (B).

Ta,b

Design of the experiments:

The experimental design was factorial in a completely randomized block design (CRB), with three replications. The treatment were

Two planting date:

(1) Spring cultivation (11th March)

(2) Autumn cultivation (24th October)

Two harvesting date: Plants were harvested at flowering stage twice each season.

(1) Spring cultivation, the first harvest was done in the middle of July and the second one in the third week of October in the two seasons.

(2) Autumn cultivation, the first harvest was done in the middle of June and the second one in the first week of October in the two seasons.

N.P.K: the recommended dose was added at the rate of 150 kg ammonium sulphate (20.5% N) and 50kg potassium sulphate (48% K_2O) per feddan (4200m^2) was applied in two equal doses with the first and second irrigation and repeat after harvest , 200kg calcium super phosphate (15.5% P_2O_5) in one dose during soil preparation.

The following data were recorded per plant:

A. Vegetative growth characters:

1. Plant height (cm).
2. Number of branches/plant.
3. Leaf area (cm^2)/leaf.
4. Fresh and dry weight (g/plant).
5. Dry yield per fed (ton).
6. Flowering date

B. Chemical analysis:

1. Chlorophyll a, b and total mg/g F.W: were determined by using the method described by Moran (1982).
2. N, P and K%:

Nitrogen percentage was determined according to microkjeldhal method (Hach *et al* 1985), phosphorus percentage was estimated according to A.O.A.C., (1970) and potassium percentage was determined by flame photometer (Brown and Lilleland, 1946).

3.Essential oil determination

3.1. Essential oil %

Essential oil percentage was estimated according to British Pharmacopoeia (1963) .

3.2. Essential oil yield

(a): Oil yield / plant (ml)

(b): Oil yield/fed (l)

3.3. Essential oil components:

GC/Mass analysis of volatile oil of each treatment was performed with specification of the apparatus used according to Robert, (1995).

Data of both seasons were tabulated and statistically analyzed according to Steel and Torrie (1980) and differences among the means of the treatments were compared by LSD Test (Snedecor and Cochran ,1980) using COSTAT computer program.

RESULTS AND DISCUSSION

A. Vegetative growth characters:

(1) Plant height, number of branches/plant and leaf area:

Significant differences were found between planting and harvesting dates in both seasons for plant height, number of branches/plant and leaf area (Table1).In the two seasons, plants at the time of the 1st cut were significantly taller than those at the time for the 2nd cut in spring as well as in autumn planting. This is because of the plants took longer period to grow which allowed more time for vegetative growth from planting to the time of the 1st cut. While maximum number of branches/plant and leaf area were recorded from the 2nd cut in spring and in autumn planting for the two seasons. This may be due to the number of branches gradually increased after the 1st cut and when the plants grow in semi-shade, they produced larger leaves and habitat than those grown in sunny condition .similar results were obtained by Moradkhani *et al* (2010) on *Melissa officinalis*, L

Regardless planting date, plants of spring produced the highest plant height, number of branches/plant and leaf area for the two seasons. The tallest plant produced from the 1st cut of spring in the two seasons .While the highest number of branches/plant and leaf area produced from the 2nd cut of spring in the two seasons. Galanopulou-Sendouca *et al* (2002) on *Artemisia annua* who found that plant height and biomass yield increased gradually from the 1st to the 5th harvest for the earliest 2 transplanting dates or 6th harvest for the later transplanting date.

Table (1): Effect of planting and harvesting dates on plant height (cm), number of branches/plant and leaf area (cm^2)/leaf of *Melissa officinalis* ,L herb during the two seasons (2008/2009 and 2009 / 2010).

Time of harvest / planting date	Plant height (cm)			Number of branches/plant			Leaf area (cm^2)/leaf		
	1st Season (2008/2009)								
	1st cut	2nd cut	Mean(A)	1st cut	2nd cut	Mean(A)	1st cut	2nd cut	Mean(A)
Spring	66.64	51.72	59.18	29.75	50.00	39.88	9.08	11.43	10.26
Autumn	53.69	45.42	49.55	16.56	35.33	25.94	8.80	6.95	7.87
Mean(B)	60.17	48.57		23.15	42.67		8.94	9.19	
LSD at 5%	A 0.88	B 2.37	AB 3.36	A 6.27	B 4.91	AB 6.94	A 0.56	B 0.63	AB 0.89
2nd Season (2009/2010)									
Spring	57.67	44.56	51.11	20.14	31.06	25.60	7.54	8.81	8.17
Autumn	42.67	36.61	39.63	12.00	25.94	18.97	6.65	7.72	7.18
Mean(B)	50.16	40.58		16.07	28.50		7.09	8.26	
LSD at 5%	A 0.22	B 2.44	AB 3.45	A 1.57	B 3.59	AB 5.08	A 0.32	B 0.52	AB 0.74

2. Fresh and dry weights/plant and dry yield per fed:

Data in Table (2) indicated that herb fresh and dry weights/plant and dry yield per fed increased gradually from the first to the second harvesting date in both seasons, however the plants at the 2nd cut were recorded the highest significant fresh and dry weight and dry yield /fed in both seasons . These results may be because of increasing the growth of root system and

tillers with increasing number of harvest, consequently, increasing the nutrients uptake needed for plant growth, besides enhancing the rates of physiological processes. Hence, the whole growth of plant could be increased. Badawy *et al* (2009) on *Artemisia annua* indicated that delaying harvesting time affected significantly all studied traits in both seasons. Delaying harvest time up to 135 days after transplanting increased herb dry yield.

Spring planting had a positive and significant effect on fresh and dry weights and dry yield per fed of plants harvested in 1st and 2nd cut as compared to autumn planting. The 2nd cut of spring planting recorded the heaviest fresh and dry weight and dry yield /fed in both. These results are supported by Sardooyi *et al* , (2011) on green cumin and Sadeghi *et al* ,(2009) on black cumin plants .

Table (2): Effect of planting and harvesting dates on fresh and dry weights (g/plant) and dry yield /fed (ton) of *Melissa officinalis* ,L herb during the two seasons (2008/2009 and 2009/2010).

Time of harvest / planting date	Fresh weight (g/plant)			Dry weight (g/plant)			Dry yield /fed(ton)		
	1st Season (2008/2009)								
	1st cut	2nd cut	Mean(A)	1st cut	2nd cut	Mean(A)	1st cut	2nd cut	Mean(A)
Spring	466.06	611.91	538.99	105.98	190.79	148.38	2.95	3.29	3.12
Autumn	289.26	268.23	278.75	132.61	147.87	140.24	2.36	4.24	3.30
Mean(B)	377.66	440.07		119.29	169.33		2.65	3.76	
LSD at 5%	A 35.20	B 51.25	AB 72.49	A 61.56	B 42.68	AB 60.35	A 1.37	B 0.95	AB 1.34
	2nd Season (2009/2010)								
Spring	329.42	427.22	378.32	95.50	103.82	99.66	2.12	2.31	2.21
Autumn	203.61	148.30	175.96	82.21	102.38	92.30	1.83	2.28	2.05
Mean(B)	266.52	287.76		88.86	103.10		1.97	2.29	
LSD at 5%	A 11.00	B 33.17	AB 46.91	A 6.90	B 11.10	AB 15.70	A 0.15	B 0.25	AB 0.35

3. Flowering date:

Fig. (1) showed that spring plants were flowered (ready to be cut) within significantly shorter time than autumn plants where ,spring plants needed 122 and 219 days to flowering (harvest) in the first and second cut ,respectively .While autumn plants needed 233 and 343 days to flowering (harvest) in the first and second cut ,respectively .The first cut, the plants took shorter time to flowering as comparing with the second cut where spring ones were harvested earlier ,they also flowered earlier than those of autumn ones and became ready for the 2nd cut at a shorter time . These results may be attributed to meteorological conditions during the experimental years Table (B) which the data indicated that flowering of lemon balm (and subsequently its harvest) is dependent on the photoperiod and is influenced by temperature. Similarly, Ibrahim, (2004) on *Achillea millefolium*,L. plants reported that spring planting flowered much earlier to reach the 1st cut and become ready for the 2nd cut at a shorter time than autumn planting .

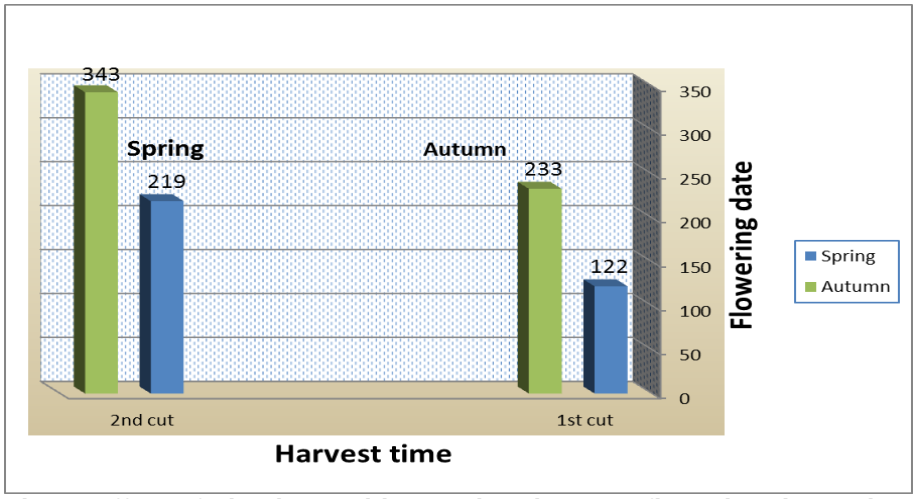

Fig .1: Effect of planting and harvesting dates on flowering date values are means

4. **Chlorophyll a, b and total** :

Data in Table (3) indicated that leaf chlorophyll a, b and total decreased gradually from the first to the second harvesting date in both seasons. Spring planting were significantly increased chlorophyll a, b and total as comparing with autumn planting in both cuts under the two seasons .The highest significant chlorophyll a, b and total were recorded for the plants cultivated in spring at the 1st cut in both seasons .These results may be due to increasing light intensity and temperature that influenced on activates various enzymes and play important role in protein synthesis, anions transport, assimilate translocation, cell respiration and stomatal movements. These results are obtained by Mann and Vyas(1999) on *Plantago ovate* and Mohammad *et al*,(2010) on *Matricaria chamomilla*

Table (3): Effect of planting and harvesting dates on chlorophyll (a, b and total) mg/g fresh weight of *Melissa officinalis* ,L herb during the two seasons (2008/2009 and 2009 / 2010).

Time of harvest / planting date	Chlorophyll (a) mg/g fresh weight			Chlorophyll (b) mg/g fresh weight			Total chlorophyll mg/g fresh weight		
	1st Season (2008/2009)								
	1st cut	2nd cut	Mean(A)	1st cut	2nd cut	Mean(A)	1st cut	2nd cut	Mean(A)
Spring	3.43	3.20	3.31	2.00	1.49	1.75	7.43	6.70	7.06
Autumn	2.76	2.55	2.66	1.08	0.54	0.81	5.84	5.09	5.46
Mean(B)	3.10	2.88		1.54	1.02		6.64	5.85	
LSD at 5%	A 0.012	B 0.107	AB 0.152	A 0.03	B 0.26	AB 0.18	A 0.04	B 0.25	AB 0.35
2nd Season (2009/2010)									
Spring	3.52	2.64	3.08	1.50	0.50	1.00	6.70	5.08	5.89
Autumn	2.57	3.20	2.89	0.73	0.04	0.39	5.38	5.56	5.47
Mean(B)	3.05	2.92		1.12	0.27		6.04	5.32	
LSD at 5%	A 0.06	B 0.01	AB 0.09	A 0.02	B 0.09	AB 0.13	A 0.02	B 0.13	AB 0.19

5. N, P and K %:

The obtained results in Table (4) indicated that 2nd cut significantly increased N, P and K % as comparing with the 1st cut in the both seasons. Spring planting had significantly increased N % of plants harvested in 1st and 2nd cuts as compared to autumn planting in the two seasons. While autumn planting significantly increased P and K % in 1st and 2nd cuts in the both seasons .The 2nd cut in spring planting was recorded the highest significant N, and P % while the2nd cut in autumn planting as gave the highest significant K % in the both seasons. In this respect, Naguib *et al* ,(2007) on *Ruta graveolens* L. who showed that the uptake of nitrogen and phosphorus gave high accumulation at second sowing date(1st November). Mann and Vyas(1999) on *Plantago ovata* reported that N., P. and K uptake by seed was significantly greater under the earliest sowing date (1st November) for coriander and (15th November) for Isabgol . Meanwhile, Lopez Camello *et al* (1995), revealed that, no significant differences in nutrient accumulation due to sowing date (27th May or 19th August) of *Coriandrum sativum*.

Table (4): Effect of planting and harvesting dates on N,P and K% of *Melissa officinalis* ,L herb during the two seasons (2008/2009 and 2009 - 2010).

Time of harvest / planting date	N%			P%			K%		
	1st Season (2008/2009)								
	1st cut	2nd cut	Mean(A)	1st cut	2nd cut	Mean(A)	1st cut	2nd cut	Mean(A)
Spring	2.55	2.72	2.63	0.36	0.65	0.50	1.64	1.81	1.73
Autumn	2.41	2.45	2.43	0.61	0.43	0.52	1.67	2.08	1.87
Mean(B)	2.48	2.59		0.49	0.54		1.65	1.94	
LSD at 5%	A 0.03	B 0.07	AB 0.09	A 0.009	B 0.03	AB 0.05	A 0.017	B 0.09	AB 0.12
	2nd Season (2009/2010)								
Spring	2.00	2.47	2.23	0.30	0.53	0.41	1.34	1.51	1.42
Autumn	2.14	2.23	2.18	0.51	0.35	0.43	1.45	1.53	1.49
Mean(B)	2.07	2.35		0.40	0.44		1.40	1.52	
LSD at 5%	A 0.01	B 0.08	AB 0.07	A 0.002	B 0.027	AB .038	A 0.03	B 0.08	AB 0.12

6. Oil %, Oil yield/plant and /fed:

Data presented in Table (5) revealed that oil %, oil yield/plant and /fed was significantly affected by harvesting time. The maximum oil % and oil yield/plant and /fed (0.38%, 0.61ml/plant and 10.00l/fed in the first season , respectively)and(0.40%, 0.41ml/plant and 6.72 l/fed in the second season , respectively) were obtained from1st cut (at flowering stage). Moradkhani *et al* (2010) on lemon balm reported that the essential oils show complex structures, essential oil rate or its chemical composition of lemon balm is strongly affected by several factors such as light intensity, nutrient, temperature, cultural practice genotype, plant part age, harvesting time, etc. for example, essential oil rate and tannin contents increase with increasing light intensity from 1000 to 1500 lux. Both essential oil content and its components depend upon the cutting height of lemon balm (Turhan ,2006) which the highest levels of essential oil have been extracted in late summer from the lower parts of the plants (Kennedy *et al*., 2006).

Significant differences were found between planting dates in both seasons. Concerning the oil % and oil yield/plant and /fed, spring planting produced the maximum oil % and oil yield/plant and /fed as comparing to autumn planting in the two seasons. The 1st cut of spring planting was recorded the highest significant oil % and oil yield/plant and /fed. These results may be due to the spring planting that increased in number and diameter of the glands and these were more pronounced on the capitates glands, as well as, on the number, than the diameter of the glands. In this respect, Khalid and Ahmed (2010) on lemon balm reported that the oil content varied greatly, in the range of 0.12 to 0.25% (0.048 to 0.1 g /plant) in the first and second cuts. The oil yield was particularly high at 5 pm (0.25% or 0.1 g / plant), in the first cutting. . Meanwhile, Shalaby *et al* (1993) found that autumn planting of *Melissa officinalis* ,L cultivated in Egypt gave a slightly higher record than spring planting.

Table (5): Effect of planting and harvesting dates on oil %, oil yield/plant and /fed of *Melissa officinalis* ,L dry herb during the two seasons (2008/2009 and 2009 / 2010).

Time of harvest / planting date	Oil %			Oil yield/plant(ml)			Oil yield/fed(L)		
	1st Season (2008/2009)								
	1st cut	2nd cut	Mean(A)	1st cut	2nd cut	Mean(A)	1st cut	2nd cut	Mean(A)
Spring	0.49	0.28	0.38	0.71	0.38	0.55	11.89	6.16	9.03
Autumn	0.28	0.33	0.31	0.51	0.36	0.43	8.12	6.01	7.06
Mean(B)	0.38	0.31		0.61	0.37		10.00	6.08	
LSD at 5%	A 4.38	B 0.01	AB 0.04	A 0.04	B 0.11	AB 0.16	A 2.49	B 1.68	AB 2.38
	2nd Season (2009/2010)								
Spring	0.44	0.33	0.38	0.46	0.32	0.39	7.48	5.30	6.39
Autumn	0.35	0.39	0.37	0.36	0.33	0.35	5.95	5.50	5.73
Mean(B)	0.40	0.36		0.41	0.32		6.72	5.40	
LSD at 5%	A 0.005	B 0.017	AB 0.02	A 0.02	B 0.05	AB 0.07	A 0.41	B 0.66	AB 0.94

7. Essential oil components:

Table (6) shows difference of oil constituents as affected by planting and harvesting dates. Eight compounds were identified in lemon balm oil as geranial (citral A), neral(citral B), camphene,β-pinene ,myrcene ,linalool ,geranyl acetate and β-caryophyllene .Planting date affected the relative percentages of the oil constituents .The geranial (citral A) was generally higher in oil spring plants followed by camphene for the 1st and 2nd cut .Meanwhile , neral(citral B) was high in autumn oil followed by geranial (citral A) in the 1st cut and ,β-pinene in the 2nd cut. Time of harvest also affected the relative percentages of the oil constituents where in the spring planting the 1st cut showed the maximum percentage in the main component geranial (citral A), followed by camphene, linalool, β-caryophyllene, neral(citral B), myrcene ,β-pinene and geranyl acetate .While the 2nd cut showed the maximum percentage in the geranial (citral A), followed by camphene(28.778 %),β-caryophyllene ,β-pinene, myrcene, linalool, geranyl acetate and neral (citral B) . In the autumn planting the 1st cut showed the maximum percentage in neral (citral B), followed by geranial (citral A) , geranyl acetate,

β-pinene, , myrcene and linalool. While the 2nd cut showed the maximum percentage in the neral(citral B), followed by β-pinene , myrcene, linalool, camphene and geranial (citral A) . The change in the components quality occurred by difference in planting and harvesting dates may be attributed to environmental factors that affect the efficiency of certain enzymes responsible for the conversion of one compound to another and result in differences in the oil composition and relative percentages of the oil constituents in lemon balm oil . Similar results are reported by Moradkhani *et al* (2010) and Meftahizade *et al* (2010) who reported that the main constituent of the essential oil are citral (geranial and neral), citronellal, geraniol, β-pinene, alpha- pinene, β- caryophyllene, comprising 96% of the oil ingredients. Khalid and Ahmed (2010) on lemon balm were obtained similar results.

Table (6): Effect of planting and harvesting dates on essential oil constituents of *Melissa officinalis* ,L plant.

Treatment / Components	Spring		Autumn	
	1st cut	2nd cut	1st cut	2nd cut
Camphene	28.145	28.778	0.306	0.331
β-Pinene	0.202	4.611	1.192	33.829
Myrcene	0.242	0.636	0.872	3.136
Linalool	3.440	0.243	0.689	2.734
Neral(citral B)	0.253	0.007	31.216	57.244
Geranial (citral A)	57.148	51.764	6.021	0.300
Geranyl acetate	0.170	0.187	3.569	-
β-caryophyllene	0.422	8.241	-	-
Total identified	90.022	94.467	33.87	97.574
Unidentified compound	9.978	5.533	66.135	2.426

CONCLUSION

This investigation can be concluded that under this research conditions spring planting was favorable for cultivation *Melissa officinalis*, L plants. The 2nd harvest time gave better results in most parameters than the 1st harvest.

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زراعة المليسا فى منطقة شمال وسط الدلتا:
(أ)تأثير مواعيد الزراعة والحصاد

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أجريت تجربتان حقليتان فى مزرعة محطة البحوث الزراعية بسخا خلال موسمى النمو ٢٠٠٨/٢٠٠٩ ، ٢٠٠٩/ ٢٠١٠لدراسة تأثير مواعيد الزراعة والحصاد على النمو والمحصول ومحتوى الزيت لنبات المليسا.تمت الزراعة فى موعديين الاولى الزراعة فى الربيع١١ مارس وفى الخريف ٢٤ اكتوبر فى الموسمين وتم الحصاد فى موعديين ١- المنزرع فى الربيع تم حصاده فى منتصف يوليو كحشة اولى والثانية فى الاسبوع الثالث من اكتوبر ٢- المنزرع فى الخريف تم حصاده فى منتصف يونيو كحشة اولى والثانية فى الاسبوع الاول من اكتوبر. وقد أوضحت النتائج ان انسب موعد لزراعة نبات المليسا بمحافظة كفر الشيخ هو الزراعة فى الربيع حيث وجد ان هذا الموعد يزيد من ارتفاع النبات وعدد الافرع والمساحة الورقية والوزن الطازج والجاف والمحصول الجاف للفدان وكلوروفيل أ وب والكلوروفيل الكلى زيادة نسبة النيتروجين والفسفور والبوتاسيوم وزيادة نسبة الزيت العطرى ومحصول الزيت للنبات وللفدان .بالنسبة للتأثير على مكونات الزيت العطري وجد ان الجيرانيال (سترال أ) هو المكون الاساسي للزيت الناتج من الزراعة بالربيع يلية الكامفن بينما النيرال (سترال ب) كان المكون الاساسي لزراعة الخريف يلية الجيرانيال (سترال أ) .الحشة الثانية كانت الافضل فى معظم الصفات بالمقارنة بالحشة الاولى .من النتائج السابقة يمكن ان نوصى بزراعة المليسا فى الربيع وحشها بعد ٢١٩ يوم (وقت التزهير) للميعاد الثانى للحصاد .

قام بتحكيم البحث

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Table (A): Physical and chemical analysis of experimental soil before cultivation

Physical analysis			Soil texture	Chemical analysis													
Sand %	Silt%	Clay%		E.c (m mhos/cm)	pH	Soluble cations(meq/ l)				Soluble anions (meq/ l)				Available N(ppm)	Available P(ppm)	Available K(ppm)	Organic matter%
						Na+	K+	Ca++	Mg++	Co_{3--}	HCo_{3--}	Cl-	So_4++				
19.31	30.42	50.27	clay	1.74	7.95	13.94	1.45	5.33	1.45	-	6.96	2.35	12.86	39.40	8.37	209.3	1.6

Table (B): Mean of some meteorological data for Kafr El-sheikh area during the three seasons of 2008,2009and2010

Month	Season 2008							Season 2009						Season 2010							
	Air temperature C°		Relative humidity (RH %)		wind Veloc-ity km/ day	Pan Evap mm/ day	Rain mm /day	Air temperature C°		Relative humidity (RH %)		wind Veloc-ity km/ day	Pan Evap mm/ day	Rain mm /day	Air temperature C°		Relative humidity (RH %)		wind Veloc-ity km/ day	Pan Evap mm/ day	Rain mm /day
	Max	Min	Max	Min				Max	Min	Max	Min				Max	Min	Max	Min			
January	18	1.4	74	58	58	163	1.2	20.0	6.8	74.5	55.5	49	198	-	21.5	7.8	83.5	55	53	182	-
February	20.4	3.0	79	63.3	81	318	1.3	22.6	7.8	80	60	79	297	4.5	24.5	9.4	84.2	55.7	76.8	294	1.2
March	25.0	5.8	77	53	72	384	-	22.0	7.0	72	52.2	84	343	-	24.3	10.0	76.3	44	110	426	-
April	27.8	8.3	70	46	98.5	615	-	27.0	11.0	75	50	100	540	-	28.2	11.0	96	40.7	96	563	-
May	29.0	10.0	70.5	42.5	105	691	-	28.7	12.6	72.5	45	135	637	-	29.6	14.4	72.6	39.5	96	690	-
June	33.0	15.0	82.5	50	106	733	-	33.6	19.0	82	43	115	813	-	33.5	19.3	79.2	43.5	102	799	-
July	32.0	15.7	80	55.7	85.2	679	-	33.0	20.2	80.0	50.6	94	726	-	32.0	20.0	82	48.2	102	721	-
August	33.0	16.3	83.2	56	79	653	-	32.4	19.0	81.5	51	77	681	-	34.0	21.2	85	50.8	93.5	680	-
September	33.5	15.0	77.3	47.7	88.7	608	-	32.5	19.0	77	46	83	635	-	33.4	19.2	82.2	48.5	88	550	-
October	28.0	11.0	70	50	74	410	0.39	30.3	16.2	75.5	48	62.4	425	-	30.7	17.0	72	45	73	401	-
November	26.0	8.0	82	53	68	317	-	26.0	10.5	77.7	50	58	269	-	26.8	11.0	82	54.2	63	283	-
December	22.0	7.0	75.5	55	50	216	0.6	22.2	88	76.5	52	64	208	-	22.0	8.3	85	55.7	58.3	181	0.29

*** Source: meteorological station at Sakha 310-07' N Latitude, 300-57'E Longitude, N. elevation 6 m.**