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The effect of planting date and agriculture media on vegetative and flowering growth, the percentage of volatile oil of the flowers Viola tricolor L

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***Abstract*---**The study was conducted in a cloth canopy, Department of Hortiagriculture and Landscape Engineering, College of Agriagriculture, University of Basra, Garma Ali's, for the agricultural season 2020-2021, to determine the effect of planting date and agriculture media, on some vegetative and flowering characteristics of Viola tricolor L., and the percentage of its volatile oil. The study was carried out using a randomized complete block design (R.C.B.D) with two factors, the first factor was planting date 10/15 and 11/15, the second factor was five means, included Loam (Z), 2 Loam: 1 animal fertilizers (2Z:1C), 3 Loam: 1 animal Fertilizers (3Z:1C), 2 Loam: 1 peat moss (2Z:1P), 3 Loam: 1 peat moss (3Z:1P). The statistical program GenStat was used to analyze the data statistically, the means were compared according to the Least Significant Difference (L.S.D) test at the 0.05 probability level. The results showed that the first date was significant, on plant height, leaves number, branches number and leaf area, it gave the highest values (25.87 cm, 65.07 leaf plant-1, 9.53 branch plant-1, 365.6 cm2 respectively), number of flowers per plant, percentage of oil and refractive index (63.40 flower plant-1, 0.4911% and 1.3482, respectively). The results also showed that the interaction between the first date and the agriculture media consisting of the Loam and peat moss at a ratio of 1:2, led to a significant increase in all vegetative traits (29.00 cm, 80 leaves plant-1, 12 branches plant-1, 389.3 cm2), the same interaction gave a significant increase in the number of flowers per plant, the percentage of volatile oil and its refractive index (76.33 flower plant-1, 0.8093, and 1.5408, respectively), compared to the control treatment.

***Keywords*---**Viola tricolor L., planting date, agriculture media, vegetative growth, volatile oil.

Introduction

Ornamental planting is gaining popularity among gardeners and city dwellers, because of their awareness of the importance of living in a green environment, as well as the beautiful scenery it offers, one of these important plants, which was an ornamental plants, they were flowering annuals, because it has different colors, it was important in landscaping (Sharma *et al.*, 2018). It was the most preferred among the plants, for role of breaking the monotony and creating diverse landscapes, in addition to its economic importance due to the increased demand, its revenue was 1.58 million dollars, according to the report of the US Department of Agriagriculture for the year 2020 (USDA, 2021). *Viola tricolor* L. is a violet plant, or the so-called rose of the picture or pansy or violet (the Trinity flower), belongs to the violet family Violaceae, one of the most famous flowering ornamental plants, which was characterized by the multiplicity of its varieties, annual, biennial, or perennial, it has ovate leaves with a serrated edge, with multicolored flowers, purple, yellow and white (Tawajen, 1987; Chevalier, 2003).

The original home of the violet plant is Europe, North Africa, and the temperate regions of Asia and the Americas, the economic and medical importance of violets is due to its flowers and leaves, the flowers contain essential oils, it was used in the production of the finest perfumes and luxurious expensive cosmetics. The Greeks used it since the fourteenth century BC as a medicinal plant to treat colds. Violet also contains important active substances such as flavonoids, methyl salicylate, resins and saponins, it was important in herbal medicine as a purifying plant and a treatment for eczema, bronchitis and rheumatism, a good diuretic, therefore, it was used in cases of cystitis. Violet oil is used to treat cases of headache and suffocation by inhalation or applying it (Al-Dojwi, 1996; Chevalier, 2003). The success of growing any plant, especially the violet plant, it is necessary to know the appropriate dates for its cultivation, during by possible to know the appropriate growth period for the plant, the planting date is one of the important factors affecting the vegetative and flowering growth characteristics, one of the determining factors for the success or failure of any plant, as choosing the appropriate date improves the vegetative growth and the quality of flowers (Zubair *et al.*, 2006).

Al-Fadagh (2009) was obtained when the aromatic pea *Lathyrus odoratus* L. was grown in Basra Governorate, three dates: 10/10, 25/10, and 10/11, the plants of the first date were significantly superior in the percentage of oil and oil yield/ plant. Al-Hassan (2011) found that the cultivation of the chamomile plant *Matricaria chamomilla* L., at Basra Governorate, on two dates: 10/10 and 25/10, the plants grown on the first date outperform 10/10 in all indicators of vegetative growth, which included plant height, number of lateral branches/plant, and total number of leaves/plant, as well as the significant superiority in the percentage of volatile oil and its refractive index. Another important factor affecting plant growth is the agriculture media, as the media differ according to their

components and available moisture content, aeration, soil pH (Conover and Poole, 1988).

The physical properties of the soil have a major role in the growth and development of plants through their direct impact on the growth of roots and their penetration into the soil, indirectly on the availability of water and nutrients, producers of flower crops exert effort and time to prepare the growing media to maintain moisture and fertilize due to its great role in plant growth (Tawajen, 1987). Sahi (2005) found in a study she conducted on the effect of six agriculture media, they were Loam, perlite, peat, sand, Loam + perlite and mix + peat (in a 1:1 volume ratio), on *Gerbera jamesonii* growth, the agriculture media had a significant effect on the vegetative growth characteristics, the treatment of peat cultivation or Loam + house was superior in improving the characteristics of vegetative growth. Al-Mukhtar and Al-Atrakji (2006) mentioned that the growth medium consists of Loam soil + sand + animal manure, it gave the largest values in the number of leaves and leaves, the largest leaf area and a percentage of the major elements N.P.K, on fougere leaves, *Nephrolepis exaltata* L., whereas, the plants planted in the middle (Loam soil + sand) gave the lowest values for the studied traits.

Bajlan (2009) found that the medium consisting of sand + peat moss in a ratio of 1: 1. It led to a significant increase in the number of leaves, whereas, the plants grown in the medium of peat moss significantly outperformed in the characteristics of seedling height, dry weight of leaves, vegetative branches, root total and amount of chlorophyll, compared with other media, namely sand, peat moss, sand + peat moss at a ratio of 1:1, sand + peat moss in a ratio of 2:1) used in the cultivation of *Albizzia lebbek* Benth. Given the importance of the coordinating violet plant in public and private gardens and the beauty of its flowers, this study was conducted to determine the best date for planting violets and the best agriculture media to encourage its cultivation.

Materials and Methods

Violet seeds were obtained by one of the private nurseries in Baghdad, of American origin, it was grown in cork dishes filled with peat moss, its specifications are shown in Table (1). Sterilize peat moss with formalin at a concentration of 4%, before planting the seeds in it and according to the dates on 10/15 and 15/11 respectively. The plants were individualized when the plants reached the fourth pair stage, at anvils with a diameter of 24 cm, they were filled with the media under study. Random samples of the media were taken for physical and chemical analyzes, according to tables (2, 3 and 4). It was carried out with a factorial experiment within a Randomized Complete Block Design (RCBD) with three replicates, with two factors, the first factor was planting date 10/15 and 11/15, the second factor was five means, included Loam (Z), 2 Loam: 1 animal fertilizers (2Z:1C), 3 Loam: 1 animal Fertilizers (3Z:1C), 2 Loam: 1 peat moss (2Z:1P), 3 Loam: 1 peat moss (3Z:1P).

The number of experimental units was 30 (10 per experimental units), thus, the number of experimental plants was 300 plants. The results were analyzed using

the statistical program Genstate, the means were compared according to the L.S.D test at the probability level of 0.05 (Al-Rawi and Khalaf Allah, 1980).

Table 1
Chemical properties of processed peat moss from the German company Klasmann Deilmann

Properties	Unit	Values
Organic matter	(%)	0.85
pH		5.5-6.5
Electrical Conductivity (EC)	ds.m^{-1}	0.5
Available nitrogen	Mg/ L^{-1}	14
Available phosphorus		10
Available potassium		18

Table 2
Physical and chemical properties of cow manure

Properties	Unit	Values
pH		7.2
Electrical Conductivity (EC)	ds.m^{-1}	9.5
Organic Carbone	g. kg^{-1}	251.23
Organic matter		430.06
Total Nitrogen		12.2
Total Phosphorus		8.4
Total Potassium		5.6

The analysis was carried out in the Marine Sciences Laboratory / University of Basrah.

Table 3
Some physical and chemical properties of the sandy (Al-Dhari) medium used as a growth media

Properties	Unit	Values
pH		7.45
Electrical Conductivity (EC)	ds.m^{-1}	2.9
Organic matter	g. kg^{-1}	0.25
Total Nitrogen		0.58
Total Phosphorus		0.53
Total Potassium		0.52
Soil properties		
Clay	%	7.5
Silt		7.5
Sand		85
Soil texture	Sandy Loam	

The analysis was carried out in the Marine Sciences Laboratory / University of Basrah.

Table 4
Some physical and chemical properties of the five agriculture media

Properties	Unit	(Z)	(2Z:1C)	(3Z:1C)	(2Z:1P)	(3Z:1P)
pH	-	7.36	7.36	7.20	6.98	6.77
Electrical Conductivity (EC)	mc/ cm	0.960	1.662	3.15	7.36	8.24
Organic matter	%	9.875	10.972	8.778	11.521	19.201
Available nitrogen	mg/ g	4.276	3.999	37.144	37.986	39.006
Total Phosphorus	mg/ g	2.409	18.396	20.586	26.061	17.301

The analysis was carried out in the Marine Sciences Laboratory / University of Basrah.

Table 5
Maximum and minimum temperatures and relative humidity during the growing season

Date	Maximum temperatures	Minimum temperatures	Relative humidity
15/10/2020	41.63	23.9	46.81
25/10/2020	38.18	23.06	65.59
5/11/2020	29.21	17.52	83.3
15/11/2020	26.49	16.05	81.9
25/11/2020	22.57	15.14	96.63
5/12/2020	21.33	12.15	97.02
15/12/2020	21.7	13.13	88.57
25/12/2020	20.18	9.59	90.01
5/1/2021	18.26	7.33	91.55
15/1/2021	19.15	9.65	85.42
25/1/2021	17.10	8.23	84.22
5/2/2021	19.56	10.45	88.89
15/2/2021	20.89	8.46	85.21
25/2/2021	21.02	9.24	86.75
5/3/2021	22.54	10.58	81.45
15/3/2021	27.04	14.04	76.82
25/3/2021	27.67	13.91	67.79
5/4/2021	27.18	14.19	69.60

Experimental measurements were taken at the flowering stage, indicators of vegetative growth included, plant height (cm), number of leaves (leaf plant^{-1}), number of branches (branch plant^{-1}), leaf area (cm^2), number of flowers (flower plant^{-1}), the percentage of volatile oil (%) and its refractive index.

Results and Discussion

Table (6) shows the effect of planting date and the quality of the agriculture media and the interaction between them on the vegetative growth indicators of violets. The effect of the date was significant on the plant height (cm), the first planting date 15/10 was significantly higher than the second planting date, it gave the highest height of 25.87 cm, compared to the second planting date, which gave the lowest height of 18.63 cm. The number of leaves increased significantly in the first date, as it gave the largest number of leaves, which was 65.07 leaf plant^{-1}, compared to the second date, which gave fewer leaves, it was 60.07 leaves plant^{-1}. Number of branches and leaf area behaved the same as for other vegetative growth traits, in its response to the effect of the first date and records the highest values were 9.53 branches plant^{-1} and 365.6 cm 2 respectively, compared with the plants grown in the second date, which gave the lowest values of 8.07 branch plant^{-1} and 326.5 cm^2, respectively.

As for the agricultural media, it had a significant effect on the characteristics of vegetative growth. The agricultural media consisting of Loam and peat moss was significantly outperformed by 2:1 (2Z:1P), on plant height, number of leaves, number of branches, and leaf area, it gave the highest values, it reached 25.42 cm, 80.17 leaf plant^{-1}, 11.67 branch plant^{-1} and 379.7 cm^2, respectively, compared to plants grown in the center of the cultivar only (Z), which recorded the lowest values for the above traits were 19.00 cm, 52.33 leaf plant^{-1}, 7.33 branch plant^{-1} and 313.4 cm^2, respectively. As for the interaction between planting date and the quality of the agricultural medium, it was significant in the vegetative growth indicators .The interaction between the planting date on 15/10 and the agricultural media consisting of Loam and peat moss 2:1 (2Z:1P) led to a significant increase, on plant height, number of leaves, number of branches, and leaf area, it reached 29.00 cm, 80.00 leaf plant^{-1}, 12.00 leaf plant^{-1} and 389.3 cm^2, respectively, compared to the lowest values reached by the plants grown at the second date in the middle of the Loa only, it reached 15.00 cm, 52.00 leaf plant^{-1}, 6.67 branch plant^{-1} and 303.0 cm^2.

Table 6
Effect of planting dates and media quality on the vegetative characteristics of *Viola tricolor* L

Treatments		ant height (cm)	number of leaves (leaf plant^{-1})	number of branches (branch plant^{-1})	leaf area (cm^2)
Plant date Means	15/10	25.87	65.07	9.73	365.6
	15/11	18.63	65.07	8.07	326.5
L.S.D$_{0.05}$		0.925	2.044	0.622	16.67
Agriculture media Means	(Z)	19.00	52.33	7.33	313.4
	(2Z:1C)	20.50	58.67	8.17	340.0
	(3Z:1C)	22.41	64.67	8.83	355.1
	(2Z:1P)	23.92	72.00	10.50	349.7
	(3Z:1P)	25.42	80.17	11.16	373.1
Interaction	L.S.D$_{0.05}$	1.463	3.232	0.983	26.36

	(Z)	15/10	23.00	52.00	8.00	323.9
	(2Z:1C)		24.00	59.67	8.67	363.1
	(3Z:1C)		26.33	65.67	9.00	382.2
	(2Z:1P)		27.00	73.00	11.00	369.5
	(3Z:1P)		29.00	80.00	12.00	389.3
	(Z)	15/11	15.00	52.67	6.67	303.0
	(2Z:1C)		17.00	57.67	7.67	316.9
	(3Z:1C)		18.50	63.67	8.67	328.0
	(2Z:1P)		20.83	71.00	10.00	329.9
	(3Z:1P)		21.83	80.33	10.33	357.0

Table (7) shows the effect of planting date and the quality of the agriculture media and the interaction between them on the number of flowers of the plant and some characteristics of the volatile essential oil, it was noted that the planting date has a significant effect on the number of flowers. First date plants outperformed in increasing the number of flowers, it gave the highest number of flowers of 63.40 flowers plant^{-1}, compared to the second date, which gave a lower number of flowers, it was 61.83 flower plant^{-1}. As for the agricultural media, the agricultural media consisting of Loam and peat moss outperformed by 2:1 significantly, it gave the largest number of flowers per plant, which was 76.17 flowers plant^{-1}, compare with other agricultural media, while the agriculture media consisting of the Loam only gave the lowest number of flowers, which was 51.17 flowers plant^{-1}.

As for the interaction between the planting date and the agricultural media, it was significant. The plants that were planted at the time 15/10 in a medium consisting of Loam and peat moss in a ratio of 2: 1 (2Z:1P) gave the largest number of flowers, which was 76.33 flowers plant^{-1}, compared with the lowest number of flowers produced by plants planted on the date 15/11 in the culture medium consisting of the mixture only, which amounted to 50.33 flower plants^{-1}. The same table shows the effect of planting date and the quality of the agriculture media and the interaction between them on the percentage of volatile essential oil, the plants of the first date outperformed 15/10 significantly in this trait, it gave the highest percentage of volatile oil, which was 0.4911%, compared with the plants of the second date that gave the lowest percentage of oil amounted to 0.3420%.

As for the effect of the agricultural environment on this characteristic, it was significant, the agricultural media consisting of Loam and peat moss with a ratio of 2:1 (2Z:1P) significantly outperformed, it gave the highest oil content of 0.6039% compared to other agricultural media. The lowest percentage of volatile oil was given by the plants grown in the medium consisting of the mixture, which amounted to 0.2277%. The interaction between the planting date and the agricultural media was significant in the percentage of oil. The plants that were planted on the first date 15/10 and the agricultural media consisting of Loam and peat moss at a ratio of 2:1 gave the highest rate of 0.8093%, compared with the lowest percentage of volatile oil amounting to 0.2146 % that resulted from planting plants on the second date 15/11 in a medium consisting of the Loam only.

Table (7) also shows the effect of planting date on the agricultural medium and the interaction between them on the refractive index of the oil, it was noted that planting at 15/10 had a significant effect in increasing the refractive index of oil, it was 1.3482 compared to the plants planted on the second date, which gave the lowest refractive index of oil was 1.2549. The effect of the agricultural media was significant in this characteristic, the plants grown in the media consisting of Loam and peat moss outperformed with a ratio of 2:1 significantly by giving the largest refractive index of oil, which was 1.4870, comparison with other agricultural media, the lowest oil refractive index of 1.1225 was obtained from plants grown in a medium consisting of the loam only. As for the interaction between the planting date and the agricultural media, it was significant in the refractive index of the oil, as the plants of the first date 15/10 that were grown in a medium consisting of citrus and peat moss at a ratio of 2:1 (2Z:1P) gave the largest refractive index of oil, which was 1.5408 .Compared with the lowest refractive index of oil, which was 1.0863, it was produced by cultivating plants at the time of 15/11 with a medium consisting of the Loam only.

Table 7
Effect of planting dates and agricultural media and the interaction between them on the number of flowers and some oil characteristics of *Viola tricolor* L

Treatments			Flowers number (flower plant^{-1})	Volatile oil (%)	Refractive index
Plant date Means		15/10	63.40	0.4911	1.3482
		15/11	61.83	0.3429	1.2549
L.S.D$_{0.05}$			1.752	0.01965	0.03767
Agriculture media Means		(Z)	51.17	0.2277	1.1225
		(2Z:1C)	57.00	0.3430	1.1892
		(3Z:1C)	61.92	0.4086	1.3129
		(2Z:1P)	66.83	0.5018	1.3962
		(3Z:1P)	76.17	0.6039	1.4870
Interaction	L.S.D$_{0.05}$		2.770	0.03108	0.05956
	(Z)	15/10	52.00	0.2408	1.1588
	(2Z:1C)		57.00	0.3782	1.2375
	(3Z:1C)		63.33	0.4650	1.3823
	(2Z:1P)		68.33	0.5621	1.4217
	(3Z:1P)		76.33	0.8093	1.5408
	(Z)	15/11	50.33	0.2146	1.0863
	(2Z:1C)		57.00	0.3077	1.1410
	(3Z:1C)		60.50	0.3521	1.2435
	(2Z:1P)		65.33	0.4415	1.3708
	(3Z:1P)		76.00	0.3985	1.4331
			3.918	0.04395	0.08423

The significant superiority of the plants of the first date in vegetative growth indicators compared to the plants of the second date may be attributed to the difference in environmental factors, as planting dates are closely related to

climatic conditions. The reason may be due to the fact that the maximum and minimum temperatures for the first date (Table 5) were suitable for the vegetative growth of the plant compared to the second date, which affected in increasing the efficiency of the photosynthesis process, positively reflected in plant growth and height (Mohamed and Yunus, 1991). Or the palace of plants may return on the second date, to lower temperatures that work to short the phalanges, or the imbalance in the production of gibberellins, which leads to a decrease in height (Erwin *et al.*, 1989), it agrees with what Al-Hassan (2011) found on the chamomile plant, as for the superiority of the cultivated plants in 15/10 in the total number of leaves, it may be due to an increase in the efficiency of the photosynthesis process and the accumulation of metabolites, stimulate the increase in cell division and the emergence of new vegetative buds, or to the formation of an abundant vegetative group represented by an increase in the number of main vegetative branches (Table, 6). As a result, the number of papers increased (Richards, 1997). As for the increase in the number of branches on the plant, it may be due to the appropriate climatic conditions represented by the appropriate temperatures for growth, which led to an increase in photosynthesis rates, reflected on the formation of a good radical group, which had an effect on increasing the production of cytokinins, counteract the action of auxin, positively and negatively affected the apical dominance in the differentiation of the vascular contact area between the lateral bud and the stem, hHelped to grow a greater number of major vegetative branches (Moore, 1982).

The plants of the first date were significantly superior to the number of flowers, the percentage of oil and the refractive index compared to the plants of the second date, that the temperature provided by this date is the most suitable for the growth of plants and the efficiency of the photosynthesis process at the source, leads to an increase in the accumulated solutes, reduced the competition between the consuming parts, particularly the flowers, reflected in the increase in oil. Or it may be attributed to the strength of the vegetative growth represented by the height of the plant, the total number of leaves and the number of vegetative branches (Table, 6), led to an increase in the primary metabolites represented by total soluble carbohydrates, led to an increase in the ratio of C/N, which has an important effect on the transformation of vegetative buds into flowering (Mohamed and Yunus, 1991). The reason may be attributed to the appropriate climate for plant growth, led to increased growth, most of the turbine materials are highly formed as a result of the high rate of photosynthesis during the day, it was most intense at noon, as reflected in the primary and secondary products of the oil (Abu Zaid, 1990 and Hassan, 2002). As for the increase in the refractive index in the first date, it may be attributed to the appropriateness of the temperatures in Table (5) during the flowering period, which led to the accumulation of dissolved solids and raising the refractive index (Al-Jabri 2005). As for the superiority of the medium consisting of Loam and peat moss in the studied traits, it may be due to the characteristics of the good ventilation of this media, which encourages the increase of root growth and the area of absorption of water and elements, thus, increasing the efficiency of the photosynthesis process and the metabolism of nutrients, which helps in vegetative growth and increase the number of flowers (Al-Sheikhly, 2010), agrees with Salih *et al.* (2020).

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