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Effect of planting date on yield and percentage of cuminaldehyde and beta pinene in herb of three cumin (*Cuminum cyminum L.*) varieties in Saveh region

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Abstract

The experiment to the effect of Planting Date and Figures on yield and percentage of cuminaldehyde and Beta pinene in herb of cumin cultivars based in Saveh region, field research was conducted in Islamic Azad University, University Park,Iran in 2011-2012. The experiment was conducted in split plot based on randomized blocks in three practices. Planting dates as main plot treatments consisted of three levels (11Nov, 23 Dec and 19Feb) and three digits (Qaen, Khaf and TR171). Elements of function included bush height, number of umbel per plant, stem diameter, number of seed umbel, weight of thousand seeds, number of umbelets in bush and seed function in addition to qualities pertinent to essence include percentage of cuminaldehyde and Beta pinene in herb was measured.We compared the results of the interaction effects of planting date; the second highest yield was obtained and figures Qaen and TR171. The results showed that the highest percentage essential oil of herb obtained from the second planting date. The essential elements of the highest in the second planting date and the lowest was in the third planting date.

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Introduction

Medicinal plants have been in use since ancient times and the important reason is the rooted believes of people in different countries for using medicinal plants. This belief, for example "there is no pain without curing with plants" with slight changes in its concept and content exists among people from east to Latin America and apparently implies the long and permanent experiences of medicinal plants usages. Since the end of ninth century because of increasing developments of different sciences, particularly pharmacy and chemistry science, the first extraction of pure chemical was carried out for medicine usages. Making these medicines caused a depression on studying the medicinal plants until the whisperings of adverse effects were heard by academics and finally the researchers found out gradually the benefits and advantages of using drugs with the effective natural materials, as they called the twentieth century "the essence of medicinal plants". The medicines that directly offered to human by nature as the geography and habitant figures of fruits and seeds are the valuable biochemistry and genetic models that should be kept in nature bank as the backing of usable drugs in the society. Copying the models, these plants are used effectively to mass production of medicines in agriculture and industry in the country (*OmidBeigi, 1998)*. There are different ideas about the geographical origin of cumin. Some have considered it as native in south Mediterranean and others higher regions of Egypt and Nil coasts (*Mozaffarian, 1983;EL-savi, 2002*).

Cumin (CuminumCyminum) belongs to apiaceae family (*Aria, 2000*). This plant is diuretic, stomachic, anti-spasmodic and a tonic for digestive system (*OmidBeigi, 2000*). This medicinal plant possesses relatively a short growing season and needs little watering (*Kafi et al., 2006*), so it has a special place in the cultivation pattern in dry and semi dry regions (*Bahati, 1990*). Cumin is cultivated in tropical regions (Iran) as fall and winter tillage, but in cold regions it is cultivated as spring tillage. There are various stresses such as dryness and heat stresses during the growing period in the cultivation regions and cumin tolerates the dryness and heat of early summer and end spring by regulating its growing season that lasts from October to May (*Kafi et al., 2006*).

Cultivation date is one of the important factors of improving the function and quality of plants belonging to apiaceae family (*Aslam, 2006; Ayuoob et al., 2008*). Studying the results obtained from different researches indicated that regarding to cumin sensitivity to weather factors specially photo period and temperature, it is necessary this plant is cultivated when there is enough opportunity to germinate because it is expected that the more dried products before germination is produced by plant, the more yield or function of seed can be obtained. The results of four cultivation dates of cumin on 8December, 30 December, 4 March and 25 March in Mashhad climate indicated that the most yield of cumin has been on 8 December and 30 December respectively with the average 850 and 767 kilogram per hectare (*Rahimian, 1991*). Essences are the compounds of secondary volatile metabolisms of plants that are obtained with various methods (*Bakkali et al., 2008*). In addition to medicinal properties, this plant has essential oil with anti-bacterial and anti-oxidant property that is applied in cosmetics, health and food industry and included 2.5 percent essence that is colorless or tending to yellow and sticky and the certain weight is 0.91-0.93 (*Zargari, 1993*).

An experiment was conducted by *Mirshekari (2004)* in order to evaluate the effects of cultivation date and density on yield and essence of cumin seed in various climate of Tabriz. The results indicated that the cultivation date on 25 March has been the best date to obtain the highest yield and essence of cumin.

Academic and functional goals

Given the importance of planting date and cultivar on grain yield and Essence the cumin and the other to determine the best planting date between cultivars cumin, no research has been done to the climate zone and Figures khaf, Gha'en, TR171 Unknown in are hence the best varieties to planting date in the region

is required.

Also

Effect of planting date on morphological and physiological parameters cumin. Determine the best planting date in three varieties Qaen, Khaf, TR171 Saveh region's climate.

The aim of the study was to determine the most suitable planting date the figures Qaen, Khaf, TR171 and promoting it among the farmers to achieve optimum performance.

Material and methods

The experiment was conducted in agriculture research field of the Islamic Azad University of Saveh located in west 5 kilometers in Saveh (with 50° longitude and east 20 min, latitude 35°and north 3 min, height from sea level about 1108 and precipitation less than 200mm). The experiment variables are: cultivation date and figure that each at 3 levels in an experiment was considered as small plots, based on the complete random blocks with 3 reiterations.

The experiment land was under wheat cultivation in the last year and the texture of soil was L.S. After preparing the land (plough, disk and leveler) and creating furrows with 40centimeter width, two non-planting lines were considered at the distances of every sub plot. Every sub plot included 3 stacks that two planting rows were considered at two sides of stacks and the length of every planting line was 4 meters. Before planting, the seeds were soaked in water for 24 to 36 hours and then with the ratio 2:1 mixed sand and with high density were planted in depth 1.5 to 2.5 centimeters. Irrigating was in 6 turns in phases: immediately after planting the seeds, 10 days after planting, after appearing 2 to 3 leaves, shooting, flowering and filling the seeds. Weeding was carried out once and thinning was performed in needed plots. Sampling and harvesting the bushes from sub plots was conducted in late May and early June when the seeds was ripen and the color of branches and leaves got yellow. When harvesting, 50 centimeters from up and down of each plot and from sides were considered as border. The harvested bushes as separated were dried in shade- sun light and transferred to lab for necessary measurements. Elements of function included bush height, number of umbel per plant, stem diameter, number of seed umbel, weight of thousand seeds, number of umbelets in bush and seed function in addition to qualities pertinent to essence include percentage of cuminaldehyde in herb and percentage of Beta pinenein herb was measured. The height of bush was measured by caliper, stem diameter by profile projector, number of umbel in bush, seed in umbel and number of umbelet in bush measured manually, the weight of thousand seeds and seed function with measuring the existing seeds in 1 square meter was calculated by using a digital balance. For getting essence, 5 gr of produced herb in each plot was selected and grinded, and then through hydro distillation method and using Clevenger apparatus the essence was calculated. The components of essence were evaluated by Gas chromatography device Perkin Elmer having automatic sampler Aoc-20i.The data obtained from experiment was analyzed statistically using software MSTAT-C. The diagrams were drawn using software Excel and the averages were compared by Danken multi-amplitude test at level %5.

Results and discussion

The climate conditions in the cultivation year of experiment is given in Table 1, the results of soil test in Table, (2-1,2-2) variance analysis in Table (3-1,3-2,3-3), averages comparison in Table(4-1,4-2,4-3).

Bush Height

The effect of cultivation date on bush height was meaningful ($p<\%1$). The bush height of cumin was influenced by figure effect meaningfully ($p<\%5$). The bush height was influenced meaningfully ($p<\%1$)by interaction of cultivation date and figure (Table 3-1). The greatest height of bush was obtained at the level of main factor from the first cultivation date (a1) and at the level of sub factor from figure (V3) TR171 was obtained. The averages comparison in interactions indicated that in the variable a1V3 the highest bush,

13.897(cm) was obtained and classified in class a. and the least wasobtained from a3V2 with amount 5.01 and classified in class d (Table 4-1).

Number of umbel per plant

The effect of planting date on number of umbel per plant was significant (p<%1). The effect of figure on number of umbel per plant was not significant. In addition the interaction between planting date and figure influenced meaningfully by number of umbel per plant (p<%5) (Table 3-1). The greatest Number of umbel per plant at the level of main factor was obtained from the first and second cultivation date (a1 and a2) and at the level of sub factor, from figure (V3) TR171. The averages comparison in the interactions indicated that in the variable 'a2V3', the greatest number of umbel per plant'21.997' was obtained and classified in class '**a**' and the least obtained in variable 'a3V2'with amount '5.348' and classified in class 'C' (Table 4-1).

Table 1. Statistics Weather in Saveh city(From Sep2011 to May 2012).

Parameter Season	Average Temperatures	Averagerelative humidity%	Rainfall mm	Sunshine hours	Average evaporation	The average minimum temperature for the Earth
Sep	22.2	36	0.2	289.9	9	13.3
Oct	10.2	73	76	158	2.2	5.5
Nov	4.6	68	1.2	203.9	0	-1.1
Dec	5.2	60	4.9	222.8	0	-1.9
Jan	3.6	59	27.6	218.6	0	-3.3
Feb	6.3	51	3.8	241.7	0	-1.7
Mar	15.2	48	45.9	235.9	6.6	7
Apr	21.7	41	5.7	286.3	9	12.6
May	27.7	28	0.6	338.4	15.3	18.8

Number of seed umbel

The effect of cultivation date on number of seed umbel was meaningful (p<%1). The number of seed umbel of cumin was influenced by figure effect meaningfully (p<%1). The number of seed umbel was influenced meaningfully (p<%5) by *interaction* of cultivation date and figure (Table 3-1). The greatest number of seed umbel at the level of main factor was obtained from the first and second cultivation date (a1 and a2) and at the level of sub factor, from figure (V3) TR171.The averages comparison in the interactions indicated that in the variable a1V3, number of seed umbel 17.22 was obtained and classified in class **a** and the least was obtained in variables a3V1, a3V2 and a3V3 with amount 3.328, 1.745 and 3.964 and classified in class "d" (Table 4-1).

Table 2-1. Shows the results of soil tests.

	Micronutrients(mg kg)			
Example	Fe	Mn	Cu	Zn
Soil	1.54	1.4	0.32	0.8
Optimal range	6.5-7.5	3.5-4	0.8-1	2-2.5

Stem diameter

The effect of planting date on stem diameter was significant (p<%1). The stem diameter of cumin was influenced by figure effect significantly (p<%1). The interaction between planting date and figure didn't affect stem diameter (Table 3-1).The greatest size of stem diameter at the level of main factor was obtained from the first and second cultivation date (a1 and a2) and at the level of sub factor, from figure (V1) Qaen.The averages comparison in interactions indicated that there is no difference between variables regarding stem diameter; and all placed in class 'a'.

(Of course the greatest stem diameter was obtained 1.336mm in variable a2V3 and the least about 0.543mm in variable a3V2)(Table 4-1).

Weight of Thousand Seeds

The effect of cultivation date on weight of 1000 seeds was not meaningful. The weight of 1000 cumin seeds was influenced meaningfully (p<%5) by figure. The interaction between cultivation date and figure didn't effect on weight of 1000 seeds (Table 3-1). As for the greatest weight of 1000 seeds, there is no difference among 3 cultivation dates at the level of main factor(but the first cultivation date is a little greater) and there is the greatest weight of 1000 seeds at the level of sub factor TR171(V3). The averages comparison in interactions indicated that there is no difference between variables for weight of 1000 seeds and all placed in class **a**. (of course the greatest weight of 1000 seeds was obtained 2.63 g in variable a1V1 and the least about 0.985 in variable a3V2)(Table 4-1).

Table 2-2. Shows the results of soil tests.

Example	SP	EC(ds/m)	pH	TNV%	OM%	N%	Available K(ppm)	Available p (ppm)	Analysis of particle size			Tissue
									Sa%	Si%	Cl%	
Soil	24	3.23	8.38	11.8	0.47	0.05	73	2.65	83	10	7	L.S
Optimal range	>40	<2.5	6.5-8.2	-	<2	>0.3	170-200	15-20	-	-	-	-

Number of umbelet in bush

The effect of cultivation date on number of umbelet in bush was meaningful (p<%1). The number of umbelet in bush of cumin was influenced by figure effect meaningfully (p<%5). The number of umbelet in bush was influenced meaningfully (p<%5) by interaction of cultivation date and figure (Table 3-2).The greatest number of umbelet in bush was obtained at the level of main factor from the second cultivation date (a2) and at the level of sub factor from figure (V3) TR171 was obtained. The averages comparison in the interactions indicated that in the variable a2V3 ,the number of umbelet in bush 107.753was obtained and classified in class **a** and the least was obtained in variables a3V1, a3V2 and a3V3 with amount 12.007, 8.498 and 12.227 and classified in class **d** (Table 4-2).

Table 3-1. Analysis of varianceTable ofthedifferent treatmentsonyieldand yield components ofcumincultivation.

Sourceschanges	Degrees of freedom	Bush Height (cm)	Number of umbel per plant	Number of seed umbel	Stem diameter(mm)	Weight of Thousand Seeds(g)
Repeat	2	2.127 ns	25.457 ns	6.547 ns	0.015 ns	1.893 ns
FactorA	2	130.32**	238.952**	465.41**	1.221**	5.312 ns
ErrorA	4	1.4	11.362	3.59	0.062	0.922
Factorv	2	16.531*	73.023 ns	41.44**	0.495**	1.15*
Interaction A*v	4	30.762**	88.354*	17.273*	0.144 ns	0.67 ns
The totalerror	12	3.78	32.739	3.557	0.054	0.286
CV%	-	21.19	28.26	22.7	21.79	19.5

*Statistically significant at the5% level.

**Statistically significantat the1% level.

ns: Nonsignificant

A :Date of planting.

V:Figure

Seed Function

The effect of cultivation date on seed function was meaningful (p<%1). The effect of figure on seed function was not meaningful. The interaction between cultivation date and figure influenced meaningfully on seed function (p<%5) (Table 3-2). The greatest seed function was obtained at the level of main factor from the second cultivation date (a2) and there is no difference among the figures at the level of sub factor (of course the figure (V3) TR171 is slightly greater than other figures). In the interactions, the averages comparing indicated that the greatest seed function was obtained in variables a2V1 and a2V3 with amount 66.633 g and 63.093 g per square meter and classified in class**a** and the least was obtained in variables a3V1, a3V2 and a3V3 with amount 7.829, 4.231 and 6.801 g per square meter respectively and classified in class d (Table 4-2).

Table 3-2. Analysis of variance Table for yield, yield components and essential oil of cumin in hundreds of different treatments on plant.

Sourceschanges	Degrees of freedom	Number of umbelet in bush	Seed Function g/m²
Repeat	2	1038.41 ns	310.835 ns
FactorA	2	800.995**	8538**
ErrorA	4	247.73	132.582
Factorv	2	4448.98*	133.253 ns
InteractionA*v	4	1210.072*	271.095*
The totalerror	12	717.413	203.109
CV%	-	23.62	22.05

percentage of Beta pinene in herb

The effect of cultivation date on percentage of Beta pinene in herb was meaningful (p<%5). The *percentage of Beta pinene in herb*of cumin was influenced by figure effect meaningfully (p<%1). percentage of Beta pinene in herb was influenced meaningfully (p<%1) by interaction of cultivation date and figure (Table 3-3). The greatest *percentage of Beta pinene in herb*at the level of main factor was obtained from the first cultivation date (a1) and at the level of sub factor, from figure's(V1،V3) Qaen and TR171. In the interactions, the averages comparison suggested that in the variables a3V1 and a3V3 the highest percentage of Beta pinene in herbwith amount 3.833 and 3.763 percent was obtained respectively and classified in class **a** and the least obtained in variables a3V2and a2V2 with amount 2.403 and 2.419 and placed in class **c** (Table 4-3).

Table 3-3. Analysis of variance Table cumin oil quality traits of different treatments on plant.

Sourceschanges	Degrees of freedom	percentage of Beta pinene in herb	percentage of cuminaldehyde in herb
Repeat	2	0.136 ns	0.019 ns
FactorA	2	1.453*	14.23**
ErrorA	4	0.144	0.282
Factorv	2	5.819**	12.066**
Interaction A*v	4	4.83**	4.42*
The totalerror	12	0.057	0. 111
CV%	-	8.20	7.99

Percentage of cuminaldehyde in herb

The effect of cultivation date on percentage of cuminaldehyde in herb was meaningful (p<%1). The percentage of cuminaldehyde in herb of cumin was influenced by figure effect meaningfully (p<%1). The percentage of cuminaldehyde in herb was influenced meaningfully (p<%1) by interaction of cultivation date and figure (Table 3-3).The greatest Percentage of cuminaldehyde in herb was obtained at the level of main factor from the second cultivation date (a2) and at the level of sub factor, from figure's (V1،V3) Qaen and TR171. In the interactions, the averages

comparison suggested that in the variable a2V1 the highest percentage of cuminaldehyde in herb with amount 5.959 percent was obtained respectively and classified in class **a** and the least obtained in variablea3V2 with amount 2.856 and placed in class**c** (Table 4-3).

Table 4-1. Mean comparisons of different treatments on yield and yield components of cumin cultivation.

Dateof planting	Figure	Bush Height (cm)	Number umbel plant	of Number per umbelet bush	of Number in seed umbel	of Stem diameter (mm)	Weight of Thousand Seeds(g)
A_1	V_1	8.476 ^{c}	9.33^{c}	3.567 ^{b}	8.443 ^{c}	0.836 ^{a}	2.63 ^{a}
	V_2	12.917 ^{a}	17.387 ^{b}	3.431 ^{b}	11.110 ^{bc}	1.092 ^{a}	2.01 ^{a}
	V_3	13.897 ^{a}	16.663 ^{b}	5.21 ^{a}	17.22 ^{a}	1.318 ^{a}	2.402 ^{a}
A_2	V_1	10.32 ^{b}	12.993 ^{bc}	3.11 ^{b}	12.22 ^{b}	0.915 ^{a}	2.007 ^{a}
	V_2	11.297 ^{ab}	11.997 ^{bc}	3.249 ^{b}	10.663 ^{bc}	0.965 ^{a}	2.258 ^{a}
	V_3	11.263 ^{ab}	21.997 ^{a}	5.723 ^{a}	15.107 ^{ab}	1.336 ^{a}	2.29 ^{a}
A_3	V_1	7.5 ^{cd}	11.373 ^{bc}	3.181 ^{b}	3.328 ^{d}	0.756 ^{a}	1.127 ^{a}
	V_2	5.01 ^{d}	5.348 ^{c}	2.17 ^{c}	1.745 ^{d}	0.543 ^{a}	0.985 ^{a}
	V_3	6.907 ^{cd}	7.21 ^{c}	5.824 ^{a}	3.964 ^{d}	0.897 ^{a}	1.67 ^{a}

Table 4-2. Average performance comparison, parts Mlkrdv percent cumin oil under different treatments on plant.

Dateof planting	Figure	Number of umbelet in bush	Number of seed umbel	Seed Function g/m2
A_1	V_1	28 cd	83.667 cde	20.51 c
	V_2	52.167 c	198.5 c	40.033 b
	V_3	83.32 b	307.1 b	46.637 ab
A_2	V_1	46 c	192.867 cd	66.633 a
	V_2	37.443 cd	134.1 d	54.263 ab
	V_3	107.753 a	368.067 a	63.093 a
A_3	V_1	12.007 d	21.741 e	7.829 d
	V_2	8.498 d	12.64 e	4.231 d
	V_3	12.227 d	18.381 e	6.801 d

General conclusion

The final results of this study indicated that the second cultivation date (23 December) is suiTable for Saveh region in order to get the greatest yield and the components of function (growth indexes). Also the highest function among the figures is TR171 and Qaen. The highest percent of essence was obtained from the first and second date (the greatest percent of oil from the first cultivation was obtained). It seems that delay in cultivation and the spring planting of cumin is not suiTable for the climate conditions of Saveh and the reason is the great sensitivity of cumin to photoperiod and temperature. Because of shortening the growing period of plant when facing with heat, the plant enters to production phase and without completing the growing phase causes this declining trend. Another reason is the proper plant establishing in fall and winter and better using of the precipitation.

Regard to the second planting date has the higher function at all aspects than the other planting dates; it appears that the reason that the second planting date is better than first planting date can be plant losses in the first planting dateand the third planting date because of facing with heat could not complete the

growing phases and had the lower function at all aspects relative to other planting dates.

Among the figures, figure TR171 had the more proper function at all aspects relative to other figures and Quen figure followed it.

The above results are compatible with (Ghorbani, R and et.al 2009); (Zarin Zadeh,R and et.al 2003);(Nezami,A and et .al 2011);(Kafi M 2006) and(Rahimian Mashhadi H1991) researches' results.

Table 4-3. Mean comparisons cumin oil quality traits of different treatments on plant.

Dateof planting	Figure	percentage of Beta pinene in herb	percentage of cuminaldehyde in herb
A_1	V_1	3.54ab	4.233b
	V_2	3.627ab	3.65bc
	V_3	2.847bc	4.847ab
A_2	V_1	3.243b	5.95a
	V_2	2.403c	4.877ab
	V_3	3.04bc	5.373ab
A_3	V_1	3.833a	4.66ab
	V_2	2.419c	2.856c
	V_3	3.763a	3.993bc

Proposition

Breeding new varieties introduced in cumin and correction with high efficiency (in terms of both performance and essential oils), measures should be taken.

Cumin cultivation among farmers who have land with cultivated land area and the other (wheat, barley, alfalfa, etc.) that is not in good economic returns cultivated cumin and other herbs to promote.

Instead of exporting cumin (raw) products such as meal, essential oils, herbal extracts, oils and ... Issued in addition to exchange technology with the oil exporting raw materials and importing manufactured products that do not.

The practice in other planting dates and other figures in Iran's foreign and indigenous populations may also be performed.

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