JOURNAL OF CURRENT RESEARCH IN SCIENCE (ISSN 2322-5009)
2013, Vol. 1, No. 2, pp:83-89
Available at www.jcrs010.com

ORIGINAL ARTICLE

EFFECT OF PLANTING DATE ON YIELD, YIELD COMPONENT AND ESSENTIAL OIL QUANTITY OF THREE CUMIN (*CUMINUM CYMINUM L.*) VARIYETIES IN SAVEH REGION

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ABSTRACT: The experiment to the effect of Planting Date and Figures on yield, yield components and quantity and quality of essential oil 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 19 Feb) 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 seed essential oil, percentage of cuminaldehyde in seed and γ- Terpinene percent of seed 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 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.

Keywords: Cumin - planting - function and performance - the quality and quantity of oil -Figures

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 (Arya, 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 (Bhati, 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; Ayub *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

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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.

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.

Figure (factors of sub plot)	Cultivation date (factors of main plot)
V1: Qaen	A1: 11 November
V2: Khaf	A2: 23 December
V3: TR171	A3: 19 February

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 seed essential oil, percentage of cuminaldehyde in seed and γ-Terpinene percent of seed 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, 25 g of produced seeds 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 tables 2-1 and 2-2; variance analysis in tables 3-1, 3-2 and 3-3; and averages comparison in tables 4-1, 4-2 and 4-3.

3.1. 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 was obtained from a3V2 with amount 5.01 and classified in class d (table 4-1).

3.2. 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).

3.3. 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).

3.4. 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).

3.5. 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).

3.6. 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).

3.7. 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).

3.8. Percentage of Seed Essential oil

The effect of cultivation date on percentage of seed essential oil was meaningful (p<%1). The effect of figure on percentage of seed essential oil was not meaningful. The interaction between cultivation date and figure influenced meaningfully on percentage of seed essential oil (p<%5) (table 3-2). The greatest percentage of seed essential oil at the level of main factor obtained from the first and second cultivation date (a1 and a2) (a2 slightly greater) and there was no difference among the figures in the levels of sub factor (V2 was slightly more than other). In the interactions, the averages comparison suggested that in the variables a1V1, a1V2, a1V3, a2V1, a2V2 and a2V3 the highest percentage of seed essential oil with amount 3.639, 4.567, 3.36, 4.527, 3.877 and 4.047 percent was obtained respectively and classified in class **a** and the least obtained in variables a3V1, a3V2 and a3V3 with amount 0.01 and placed in class **b** (table 4-2).

3.9. Percentage of γ-Terpinenein seed

The effect of cultivation date on percentage of γ-Terpinene in seed was meaningful (p<%1). The percentage of γ-Terpinene in seed of cumin was influenced by figure effect meaningfully (p<%5). The percentage of γ-Terpinene in seed was influenced meaningfully (p<%1) by interaction of cultivation date and figure table 3-3. The greatest percentage of γ-Terpinene in seedat 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. In the interactions, the averages comparison suggested that in the variables a1V3, and a2V2 the highest percentage of γ-Terpinene in seed with amount 1.483and 1.34 percent was obtained respectively and classified in class **a** and the least obtained in variables a3V1, a3V2 and a3V3 with amount 0.01 and placed in class **d** (table 4-3).

3.10. Percentage of cuminaldehyde in seed

The effect of cultivation date on percentage of cuminaldehyde in seed was meaningful (p<%1). The percentage of cuminaldehyde in seed of cumin was influenced by figure effect meaningfully (p<%1). The percentage of cuminaldehyde in seed was influenced meaningfully (p<%1) by interaction of cultivation date and figure table 3-3. The greatest percentage of cuminaldehyde in seed 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. In the interactions, the averages comparison suggested that in the variables a1V3, and a2V1 the highest percentage of cuminaldehyde in seed with amount 37.43and 38.333 percent was obtained respectively and classified in class **a** and the least obtained in variables a3V1, a3V2 and a3V3 with amount 0.01 and placed in class **d** (table 4-3).

Table 1: Statistics Weather in Saveh city (From Sep 2011 to May 2012)

Parameter / Season	Average Temperatures	Average relative 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

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

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	-	-	-	-

Table 3-1: Analysis of variance table of the different treatments on yield and yield components of cumin cultivation

Sources changes	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
Factor A	2	130.32**	238.952**	465.41**	1.221**	5.312 ns
Error A	4	1.4	11.362	3.59	0.062	0.922
Factor v	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 total error	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 the 5% level.
**Statistically significant at the 1% level.
ns: Nonsignificant
A :Date of planting
V: Figure

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

Sources changes	Degrees of freedom	Number of umbelet in bush	Seed Function g/m²	percentage of Seed Essential oil
Repeat	2	1038.41 ns	310.835 ns	0.156 ns
Factor A	2	800.995**	8538**	48.212**
Error A	4	247.73	132.582	0.048
Factor v	2	4448.98*	133.253 ns	0.298 ns
Interaction A*v	4	1210.072*	271.095*	0.604*
The total error	12	717.413	203.109	0.229
CV%	-	23.62	22.05	17.87

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

Sources changes	Degrees of freedom	percentage of γ-Terpinenein seed	Percentage of cuminaldehyde in seed
Repeat	2	0.054 ns	0.139 ns
Factor A	2	2.308**	3238.57**
Error A	4	0.02	0.054
Factor v	2	0.157*	9.816**
Interaction A*v	4	0.644**	61.64**
The total error	12	0.016	0.321
CV%	-	21.72	2.59

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

Date of planting	Figure	Bush Height (cm)	Number of umbel per plant	Number of umbelet in bush	Number of seed umbel	Stem diameter (mm)	Weight of Thousand Seeds (g)
	V_1	8.476 ^{c}	9.33^{c}	3.567 ^{b}	8.443 ^{c}	0.836 ^{a}	2.63 ^{a}
A_1	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}
	V_1	10.32 ^{b}	12.993 ^{bc}	3.11 ^{b}	12.22 ^{b}	0.915 ^{a}	2.007 ^{a}
A_2	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}
	V_1	7.5 ^{cd}	11.373 ^{bc}	3.181 ^{b}	3.328 ^{d}	0.756 ^{a}	1.127 ^{a}
A_3	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

Date of planting	Figure	Number of umbelet in bush	Number of seed umbel	Seed Function g/m2	percentage of Seed Essential oil
A_1	V_1	28 cd	83.667 cde	20.51 c	3.693 a
	V_2	52.167 c	198.5 c	40.033 b	4.567 a

	V_3	83.32 b	307.1 b	46.637 ab	3.36 a
	V_1	46 c	192.867 cd	66.633 a	4.527 a
A_2	V_2	37.443 cd	134.1 d	54.263 ab	3.877 a
	V_3	107.753 a	368.067 a	63.093 a	4.047 a
	V_1	12.007 d	21.741 e	7.829 d	0.01 b
A_3	V_2	8.498 d	12.64 e	4.231 d	0.01 b
	V_3	12.227 d	18.381 e	6.801 d	0.01 b

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

Date of planting	Figure	percentage of γ-Terpinenein seed	Percentage of cuminaldehyde in seed
	V_1	0.607 bc	30.670 b
A_1	V_2	0.323 c	33.42 ab
	V_3	1.483 a	37.433 a
	V_1	0.807 b	38.333 a
A_2	V_2	1.34 a	29.387 bc
	V_3	0.707 bc	27.667 c
	V_1	0.01 d	0.01 d
A_3	V_2	0.01 d	0.01 d
	V_3	0.01 d	0.01 d

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 Zarinzadeh *et al.*, (2003); Nezami *et al.*, (2011); Kafi *et al.*, (2006) and Rahimiyan (1992) researches' results.

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