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Effect of planting date on physiological indexes of percentage α -terpineole and beta pinene in the three varieties of cumin (*Cuminum cyminum* L.) seed essential oil in Saveh region

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ABSTRACT

In Order to study the effect of Planting Date and Figures on physiological indexes and essential oil of cumin (*Cuminum cyminum* L.), an experiment was conducted at research field of Faculty of Agriculture, Islamic Azad University, Saveh, 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 (11 Nov, 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, number of umbelets in bush and seed function in addition to qualities pertinent to essential include percentage of seed essential oil, percentage of α - Terpineole in seed and Beta pinene percent of seed was measured. we compare 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: *Cuminum cyminum*, Planting Date, physiological indexes, α -Terpineole, Beta pinene

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 [20]. 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 [18];[9].

Cumin (*Cuminum Cyminum*) belongs to apiaceae family [2]. This plant is diuretic, stomachic, anti-spasmodic and a tonic for digestive system [20]. This medicinal plant possesses relatively a short growing season and needs little

watering [13], so it has a special place in the cultivation pattern in dry and semi dry regions [7]. 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 [13].

Cultivation date is one of the important factors of improving the function and quality of plants belonging to apiaceae family [3]; [4]. 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 8 December, 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 [21]. Essences are the compounds of secondary volatile metabolisms of plants that are obtained with various methods [5]. 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 [25].

An experiment was conducted by [16] 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.

MATERIALS 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 table 2 and diagrams in below figures are shown.

Bush Height

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 (fig 1).

Number of umbel per plant

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' (fig 2).

Number of seed umbel

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 (fig 3).

Stem diameter

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) (fig 4).

Number of umbelets in bush

The greatest number of umbelets 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 umbelets in bush 107.753 was 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 (fig 5).

Seed Function

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 (fig 6).

Percentage of Seed Essential oil

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 (fig 7).

Percentage of α -Terpineole in seed

The greatest percentage of α -Terpineole in seed at the level of main factor was obtained from the second cultivation date (a2) and at the level of sub factor, from figure (V1) Qaen. In the interactions, the averages comparison suggested that in the variables a1V1, and a2V3 the highest percentage of α – Terpineole in seed with amount 10.637 and 10.56 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 c (fig 8).

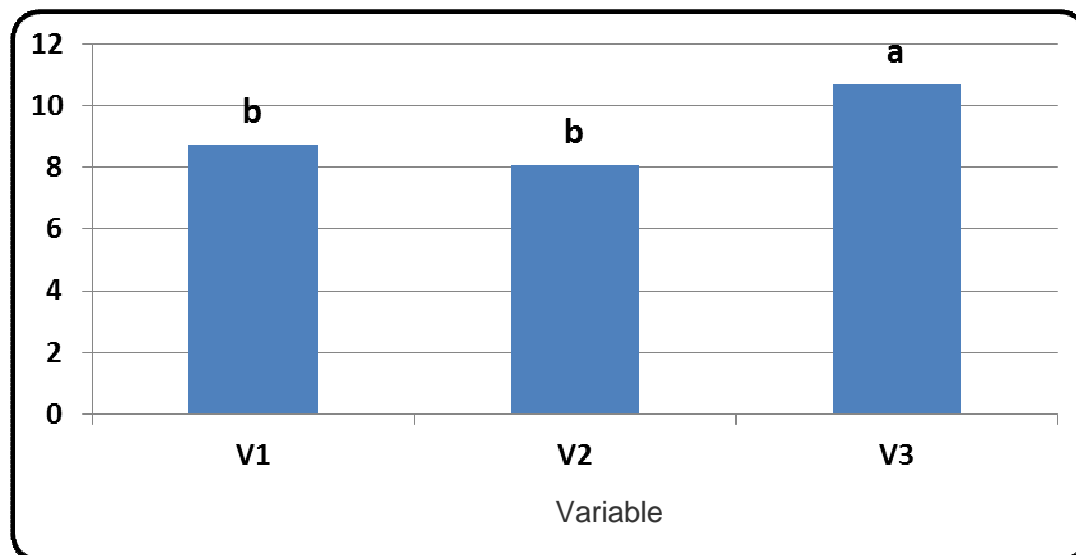
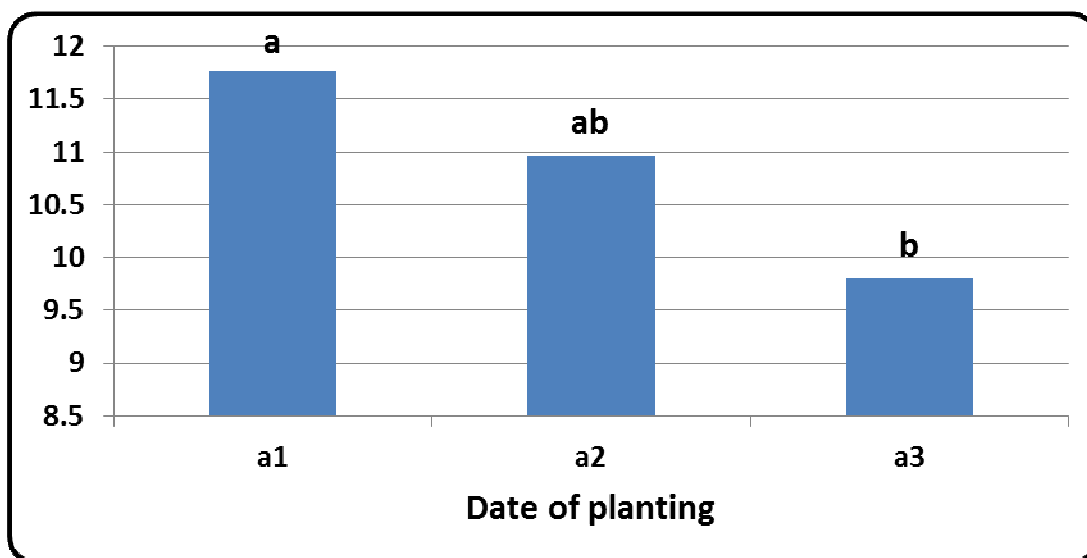
Percentage of Beta pinene in seed

The greatest percentage of Beta pinene in seed at the level of main factor was obtained from the first and second cultivation date (a1 and a2) and there is no difference among the figures at the level of sub factor (of course the figure (V1) Qaen is slightly greater than other figures). In the interactions, the averages comparison suggested that in the variables a1V1, a1V2 and a2V3 the highest percentage of Beta pinene in seed with amount 7.313, 7.383 and

7.277 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 c (fig 9).

Table1: Statistics Weather in Saveh city (From Sep2011 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



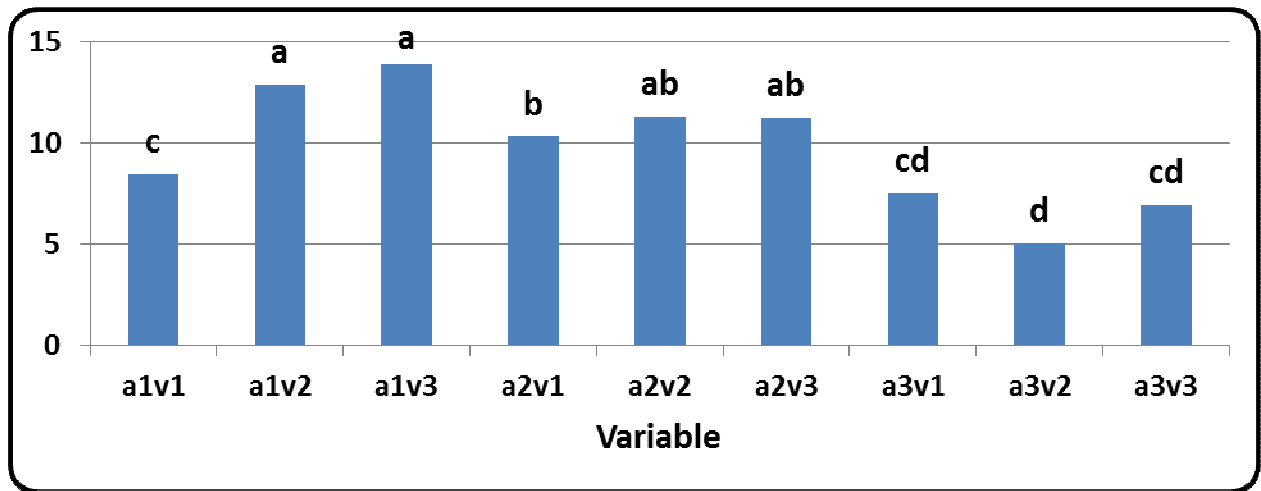
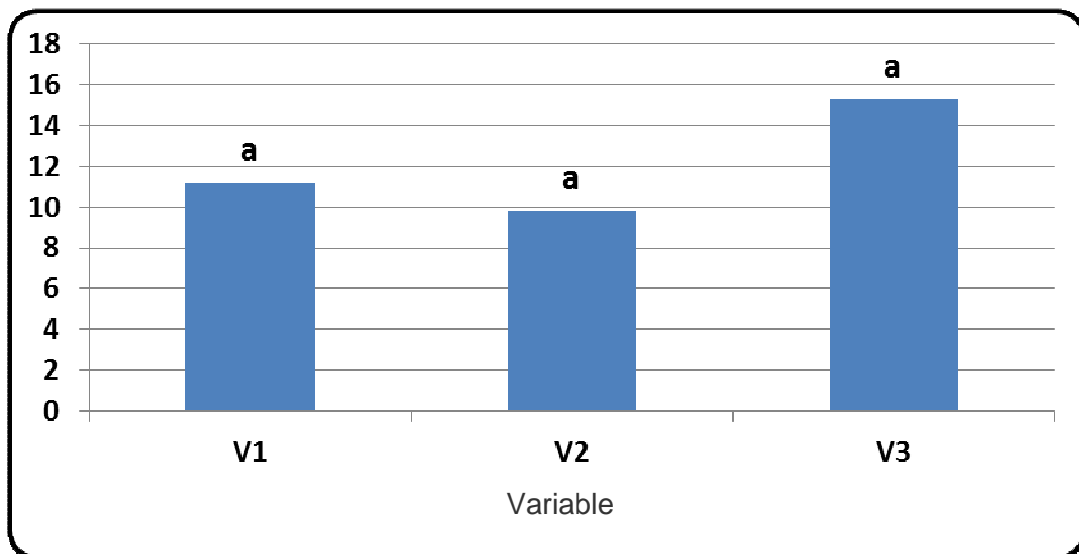
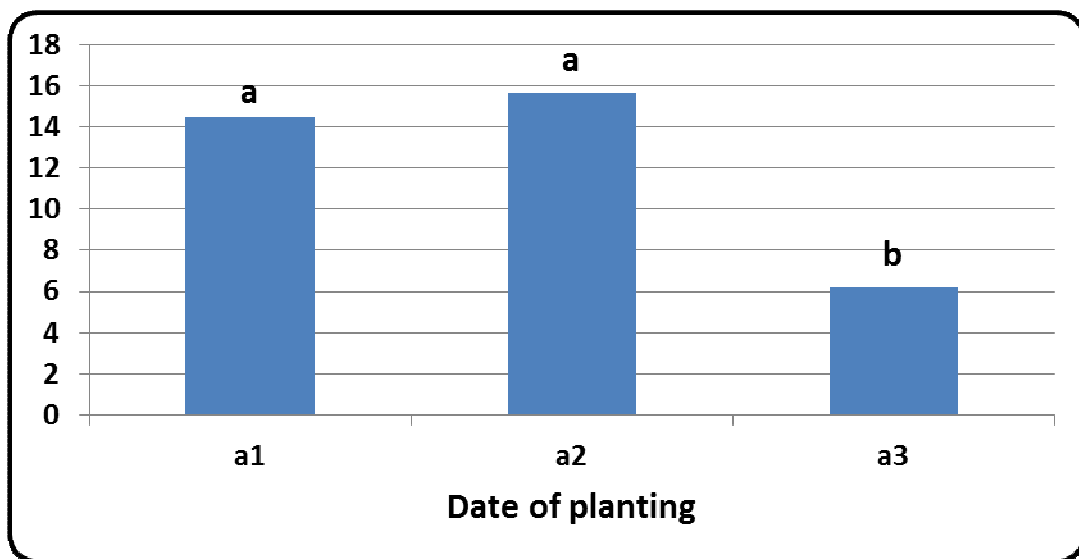


Fig 1: Bush Height



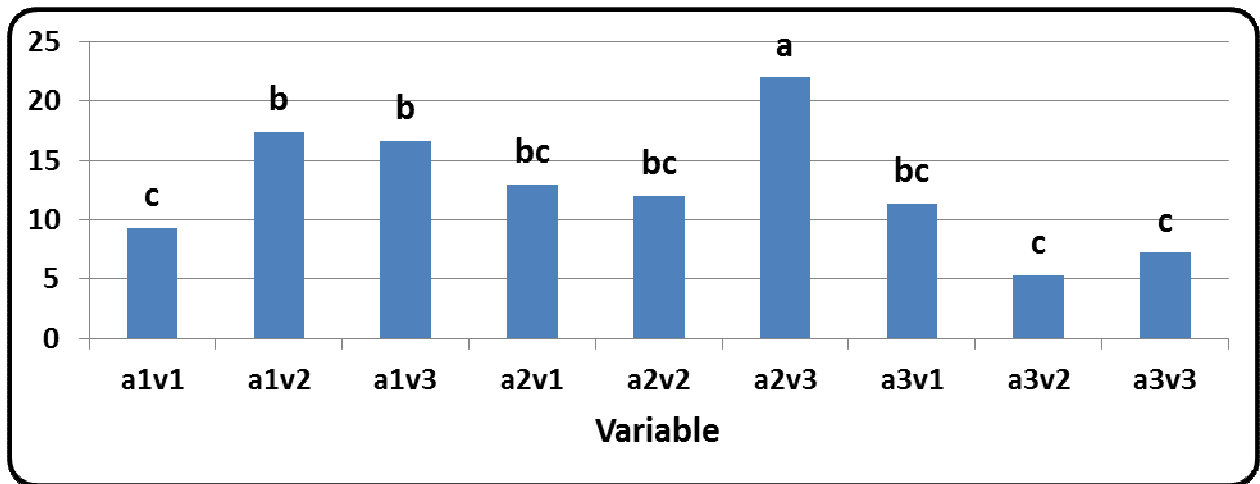
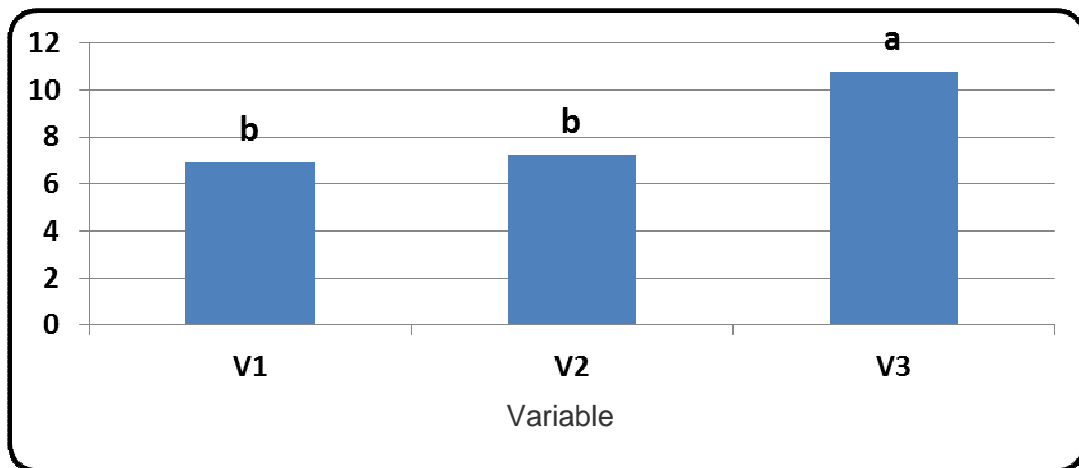
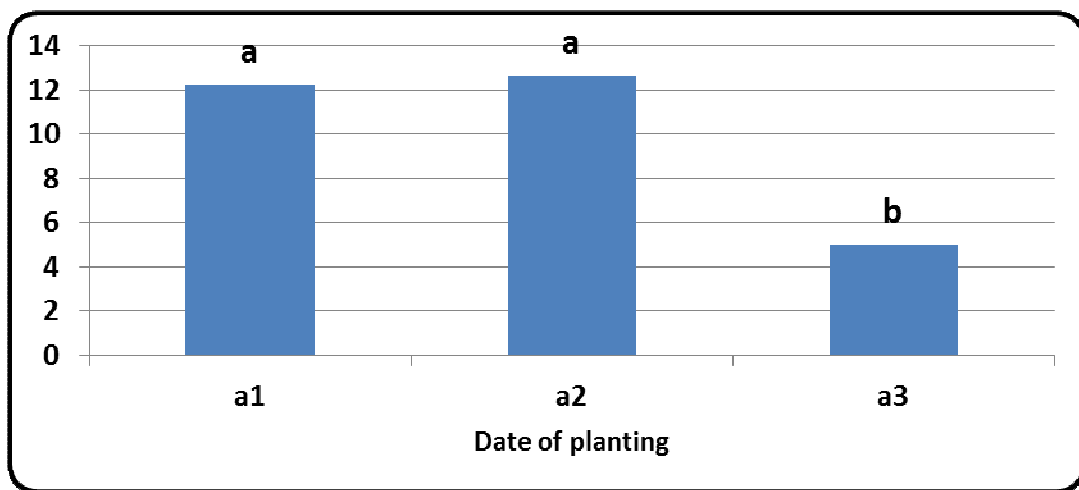


Fig 2: Number of umbel per plant



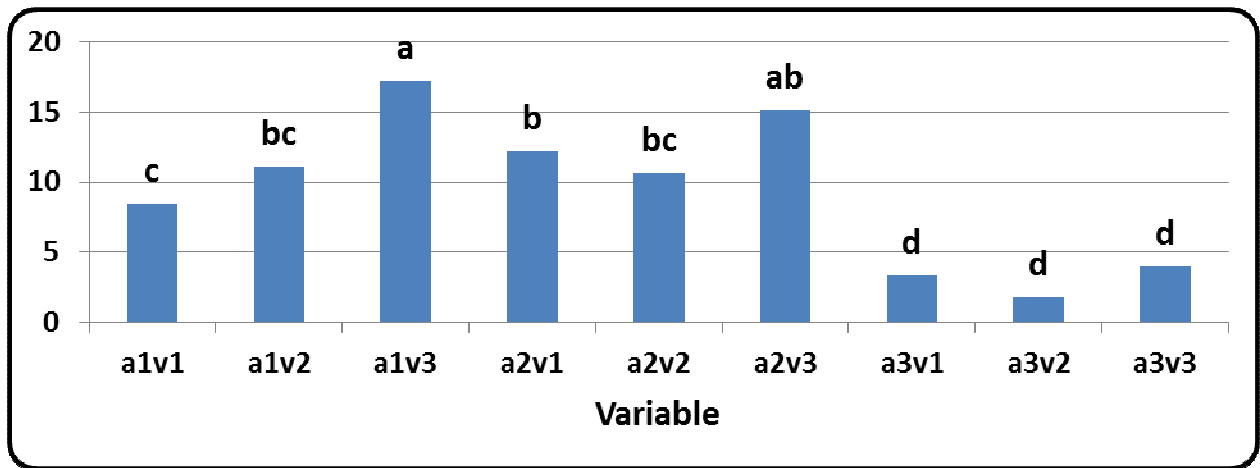
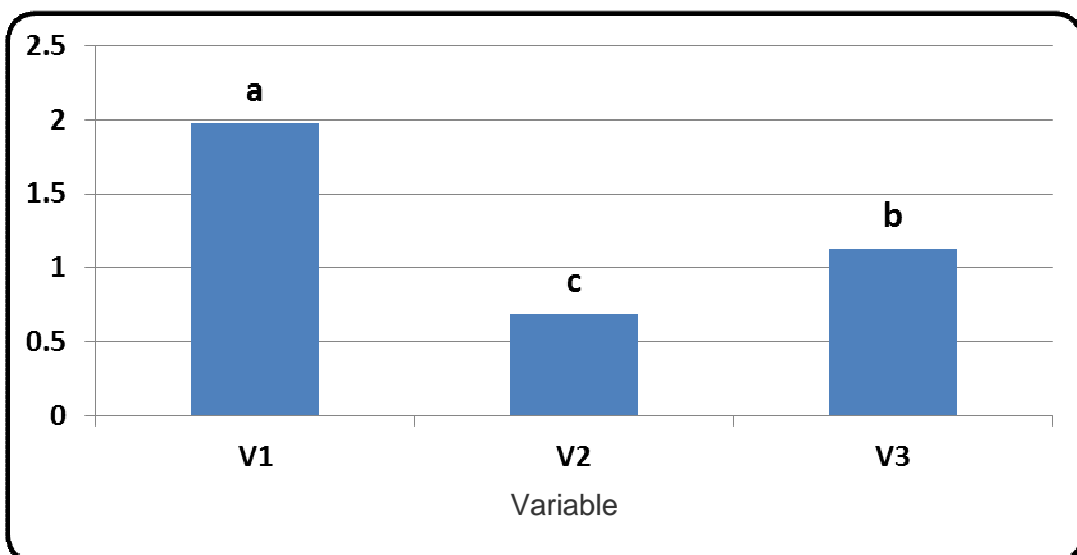
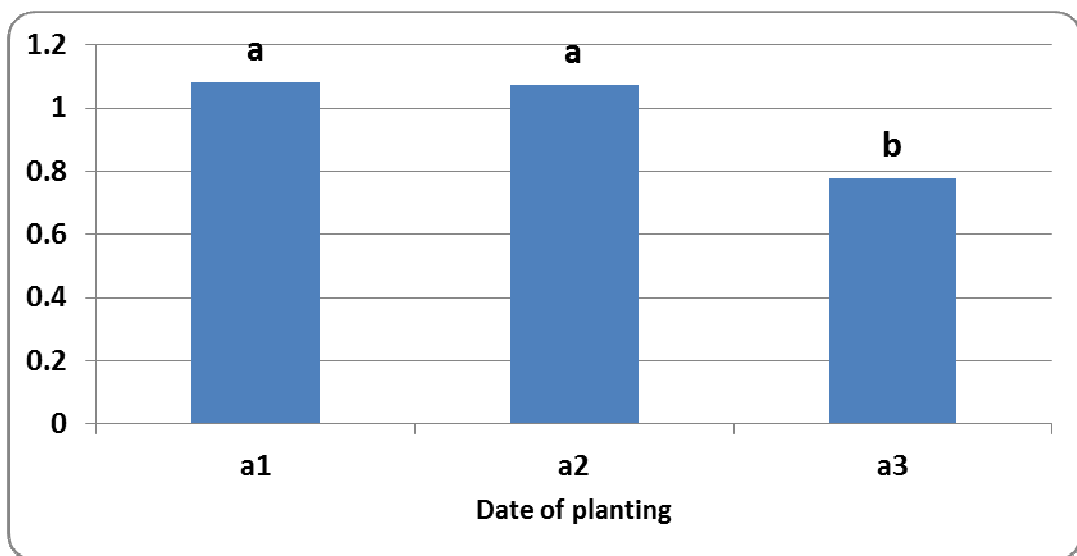


Fig 3: Number of seed umbel



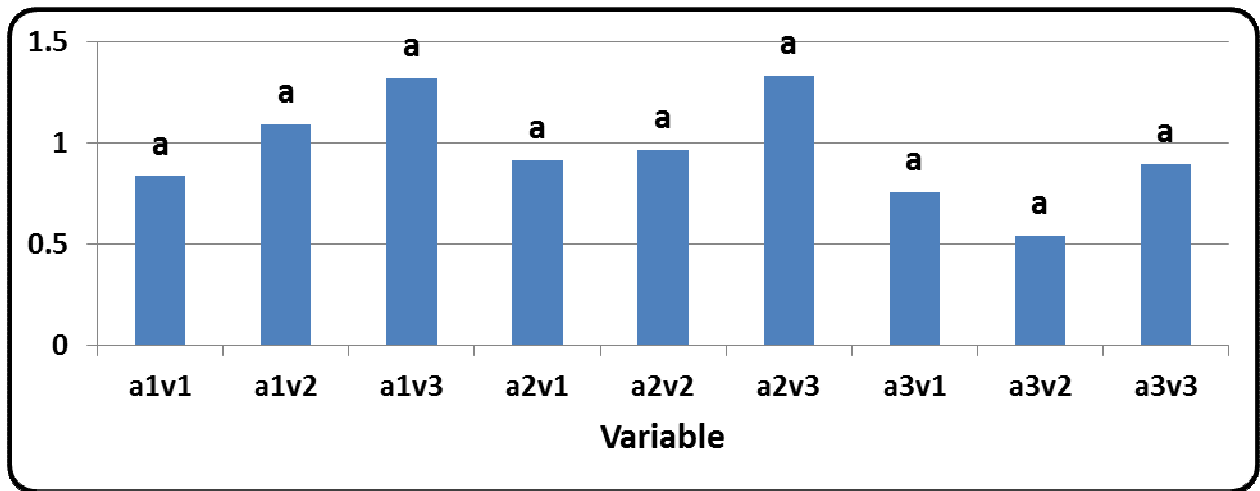
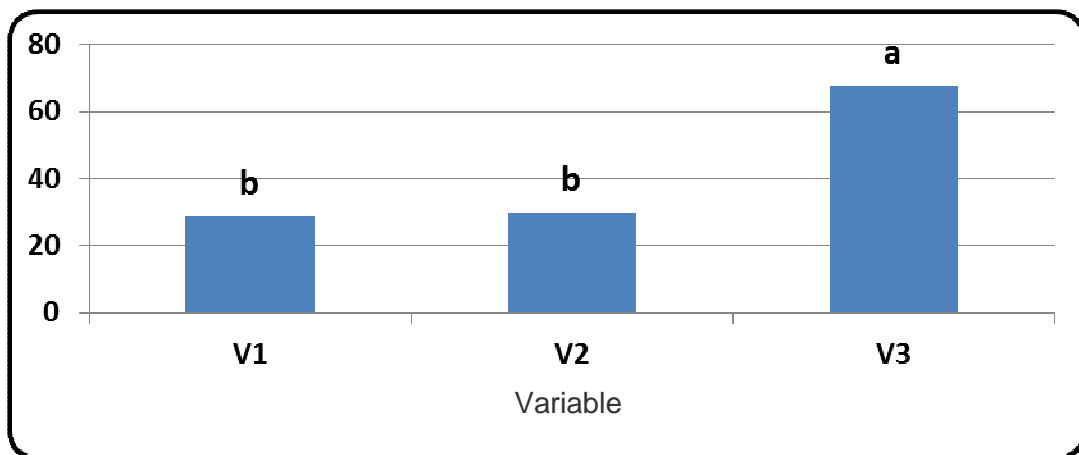
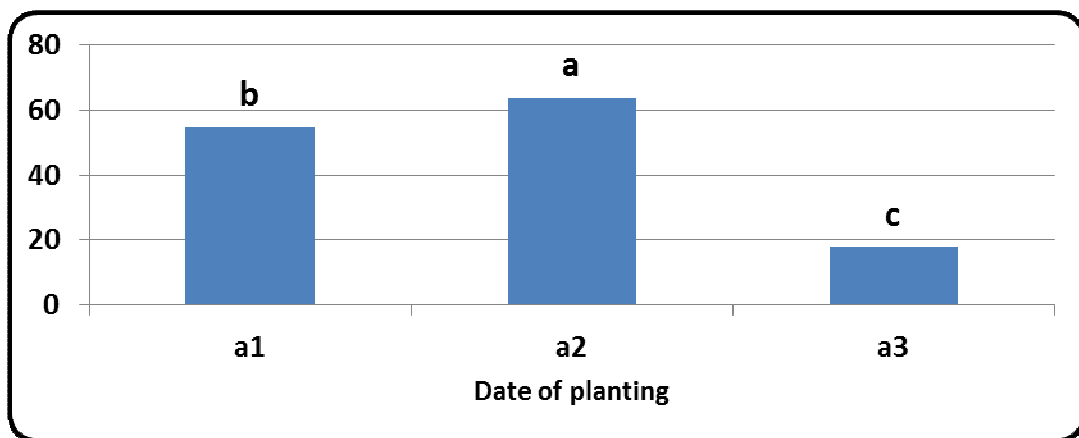


Fig 4: Stem diameter



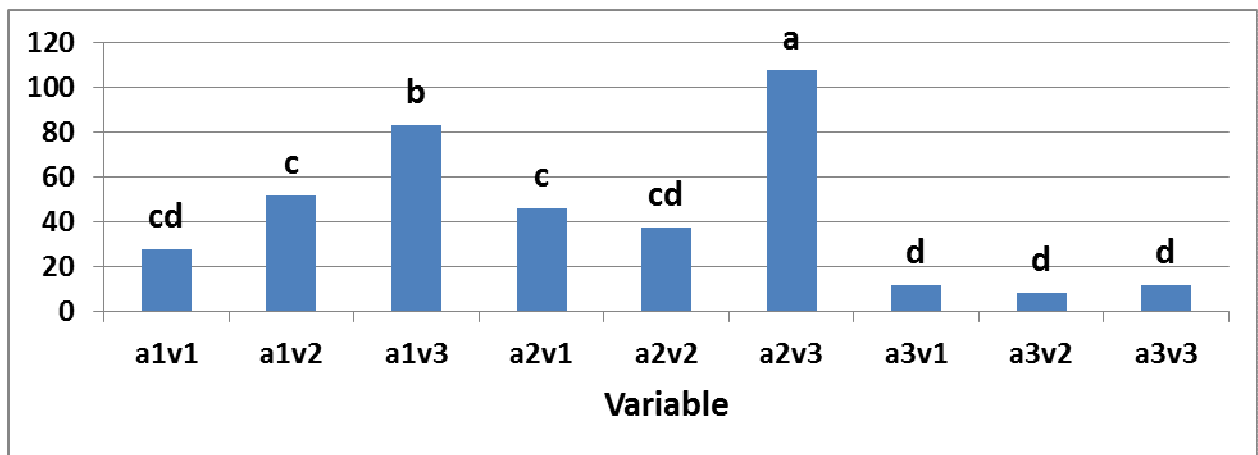
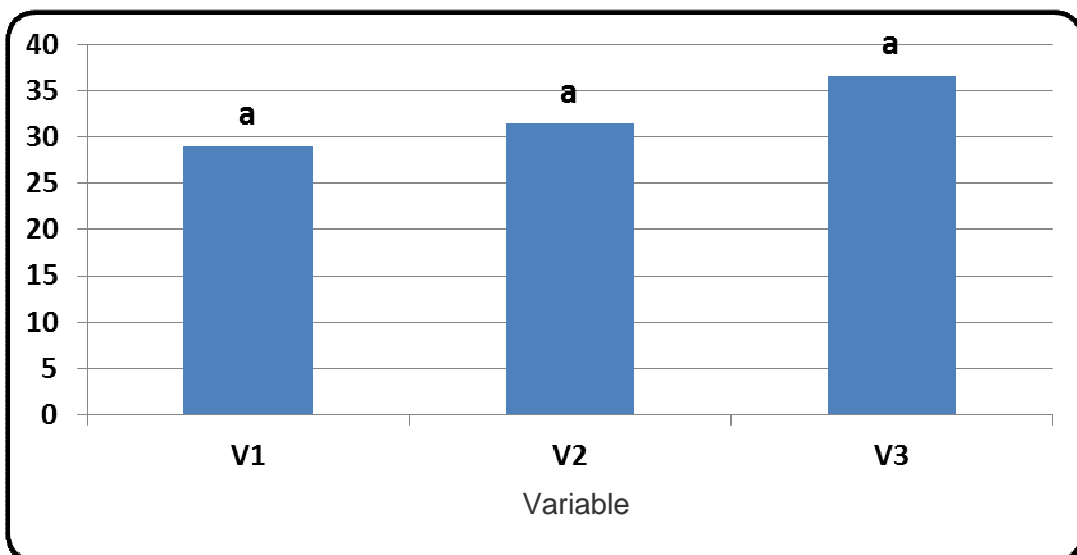
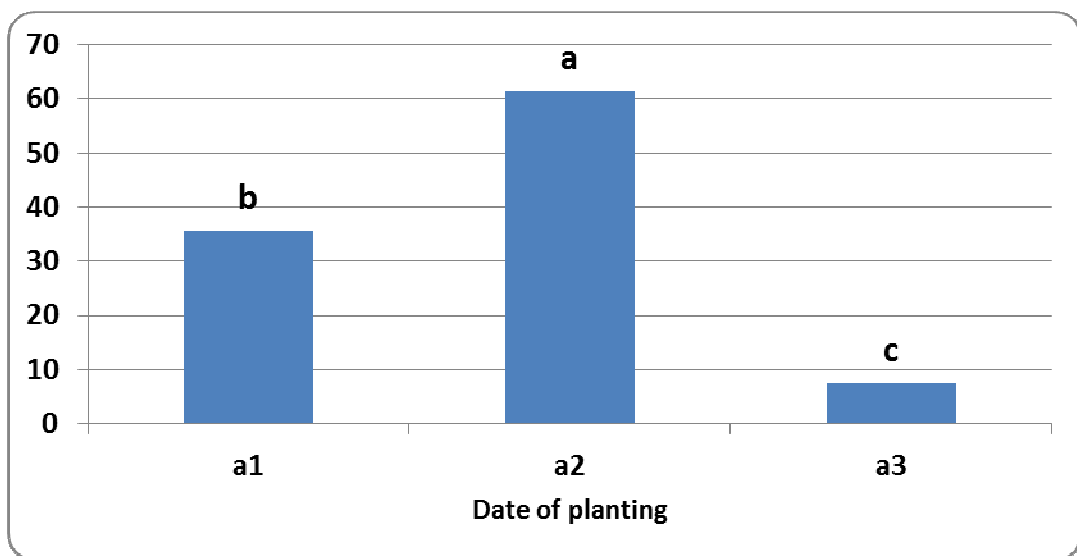


Fig 5: Number of umbels in bush



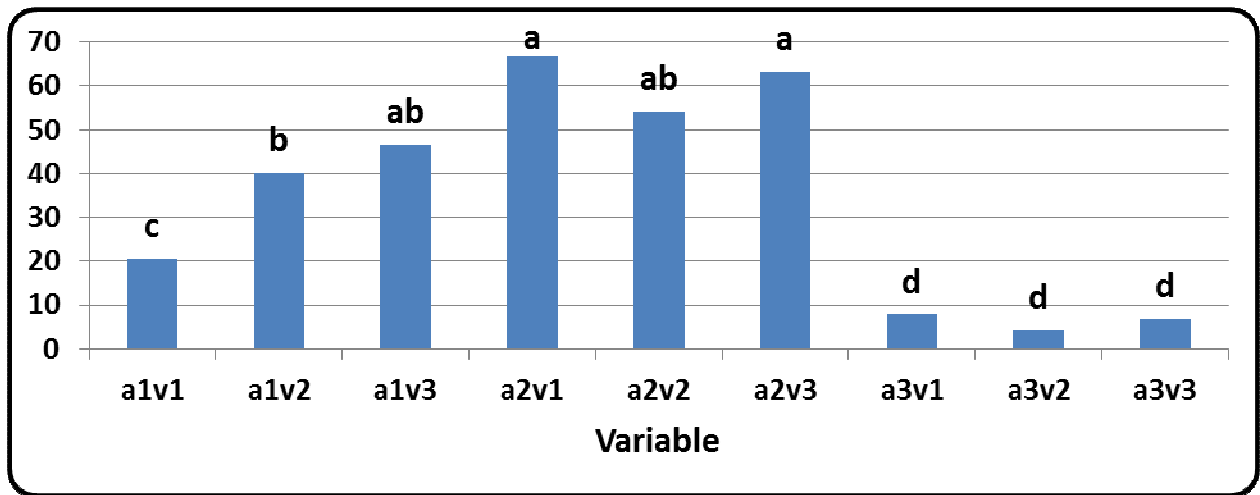
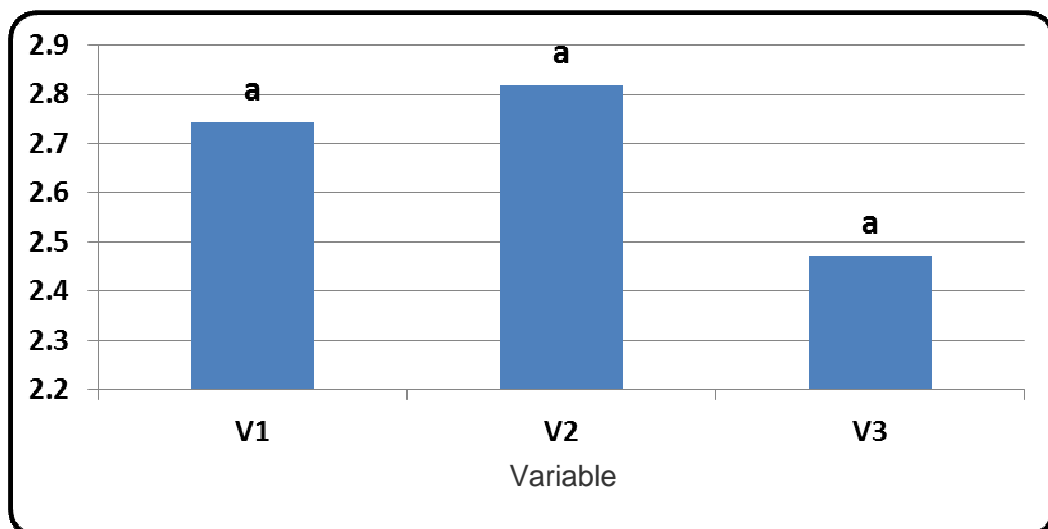
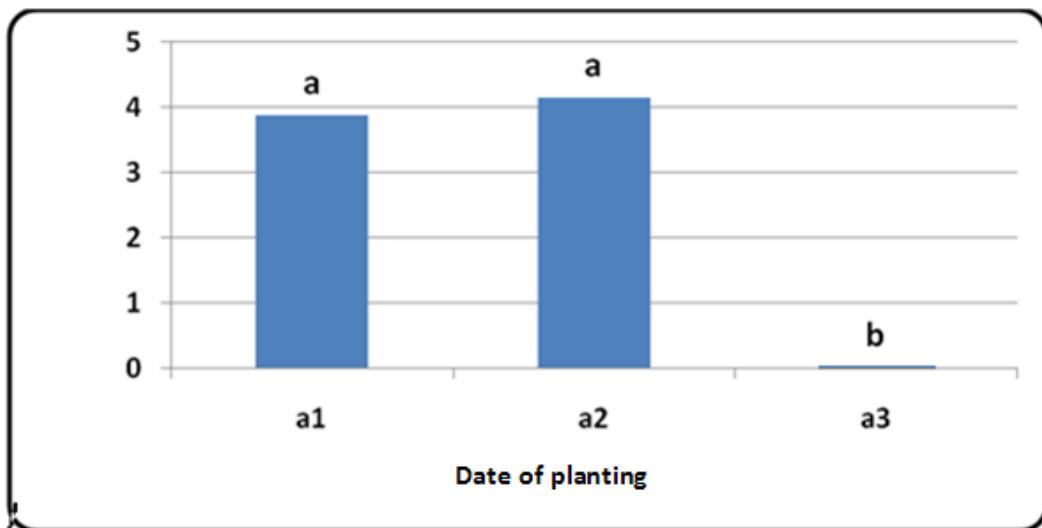


Fig 6: Seed Function



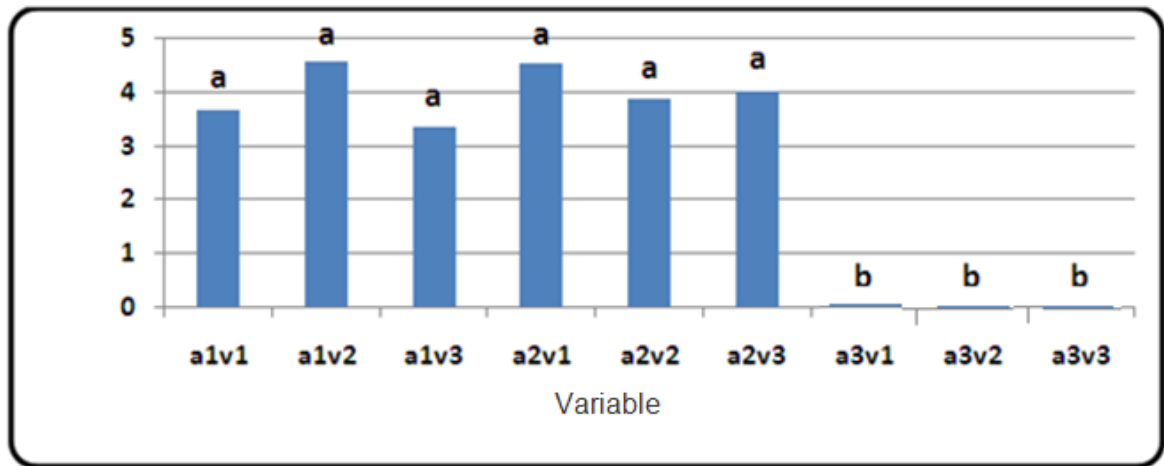
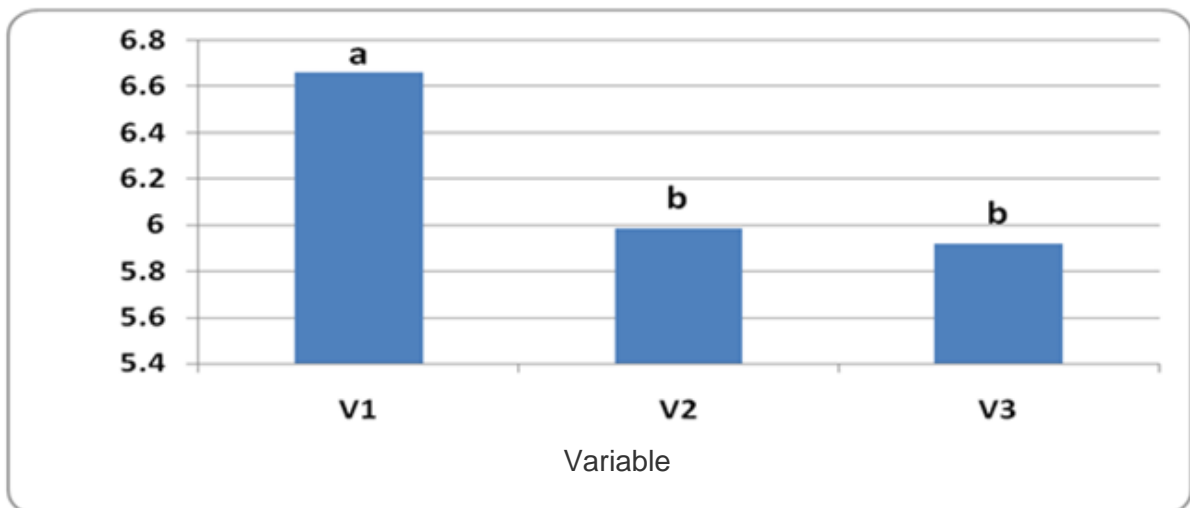
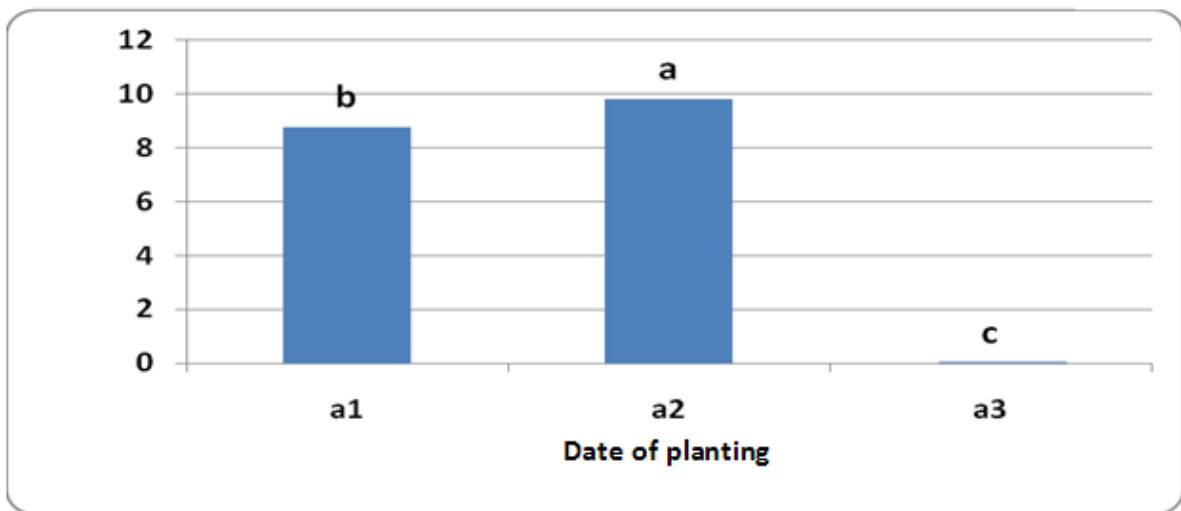


Fig 7: Percentage of Seed Essential oil



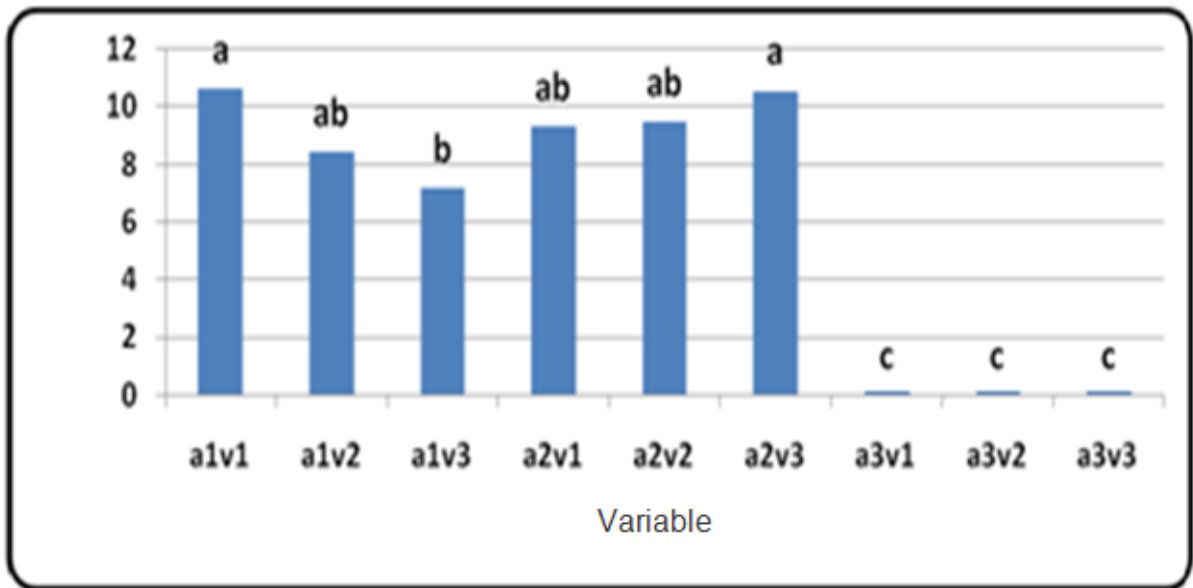
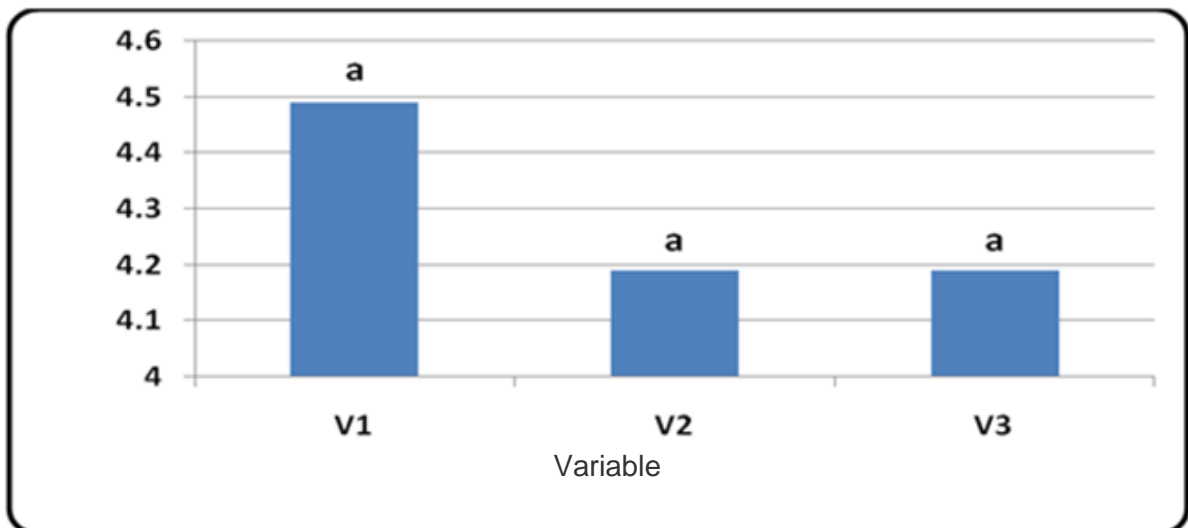
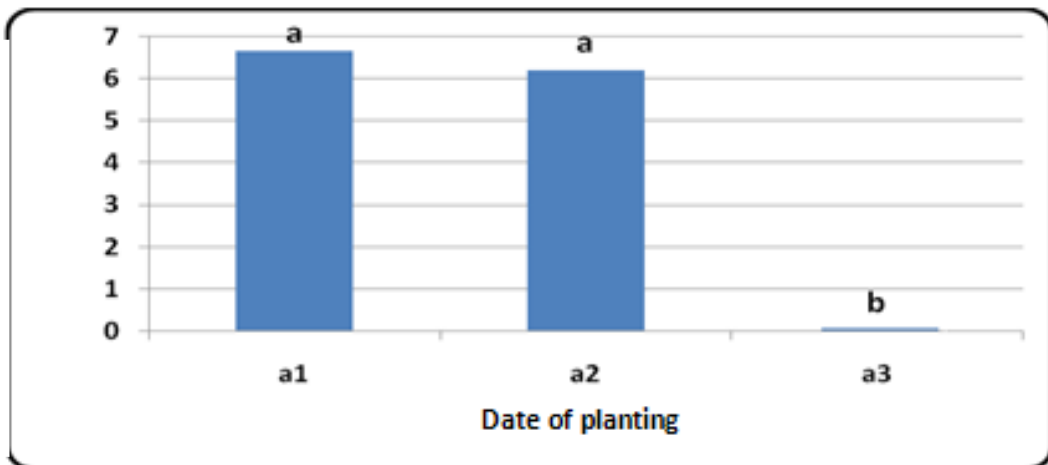


Fig 8: Percentage of α -Terpineole in seed



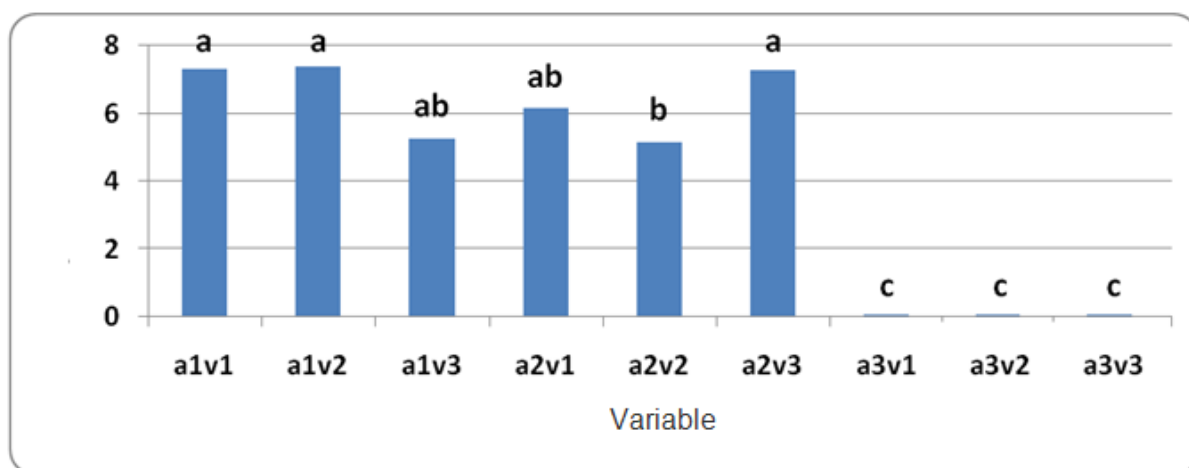


Fig 9: Percentage of Beta pinene in seed

Table 2-1: The results of soil tests

Example	Micronutrients(mg kg)			
	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: 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	-	-	-	-

Cultivation date is one of the important factors of improving the function and quality of plants belonging to apiaceae family [3]; [4]. Studying the results obtained from different researches indicated that regarding to cuminaldehyde 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 [10]. The results of four cultivation dates of cuminaldehyde on 8 December, 30 December, 4 March and 25 March in Mashhad climate indicated that the most yield of cuminaldehyde has been on 8 December and 30 December respectively with the average 850 and 767 kilogram per hectare [21].

[14] During their studies the maximum and minimum number of umbels per plant for growing plants on the Persian date 16 Oct and 15 Nov, respectively, 19 and 9.7 were reported. [22] Delay in sowing cuminaldehyde is known to reduce plant height. [23] Showed that most number of seed umbel of planting date on 11 Nov and the lowest was of 17 Mar. [8] In the course of their research on medicinal plants *Trachyspermum ammi* (Linn) expressed stem diameter decreased with delay in planting. [11] Found that delayed planting in the shed of Umbrella of 9 December than 28 Feb, followed by reduction of the plant shed. During his research conducted in the area Zahak expressed as percentage of seed Cuminaldehyde spring planting fall planting is over (52%, 48%).

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 cuminaldehyde is not suitable for the climate conditions of Saveh and the reason is the great sensitivity of cuminaldehyde 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

date and 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 [11], [24], [19], [13] and [21]) researches' results.

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