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Factors Affecting on Essential Chemical Composition of *Thymus kotschyanus* in Iran

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Abstract: The objective of this research is to find the relationship between the factors of soil and the other region plants effective on the quantity and the change of the chemicals in *T. kotschyanus*, a typical herb geographically located in Damavand, Iran. To carry out this research, after locating the breeding ground in the region under investigation, the selected species was collected at the time of flowering. Then the related parameters such as: the population, density, production, frequency, covering crown percentage, plant height major and minor diameters measurement the plot diagram was used. As a whole 60 plot along the six 50 m. transactions were made. These plots were made diagonally and perpendicularly. In addition, the study of the soil is made by taking 15 profiles from the base of the plants. In every specimen the analysis of pH, EC, SAR, K, Na, N, $CaCo_3$ and OC and the texture of the soil is measured. Data is made according to the environmental features and the species, by the RDA method in the CANOCO software environment and by the multivariable regression method, the relationship between the characteristics of the species with the environmental characteristics were selected. The results of the research showed that amount of organics, phosphorous and the acidity (r =0.99) and from the species factors average and the cover percentage and the plant height (r=0.85) effected on essential oil percentage and the total compounds with SAR and pH of the soil and production of the plant had a significant difference ($P<0.05$). In addition, the percentage of the Carvacrol and the altitude of the region have a direct and significant effect with the plant height. The altitude of the region, organics percentage, SAR has a direct and significant effect on Timol and the percentage of nitrogen and $CaCo_3$ have a negative relationship with the changes of Timol.Among the factor of the species, the percentage of Timol has a direct and significant proportion with the density of the plant (r =0.99).

Key words: *T. kotschyanus* · Essential Oil · Soil Factors · RDA · Multivariable Regression Method · Damavand

INTRODUCTION

Today medical plants and their derivatives include 20% of the pharmaceutical equipment in the developed industrial countries and 80% in developing countries [1]. The country of Iran has special and strategic situation as for as it's geopolitical and its region is can care as a result it is all of the rarest counties with climatically variation, plant species, including its heeling-industrial hales. Iran could be accounted for its rich bank of genes with various collections of God's gifty [2, 3]. Understanding of the ecological procedures is the main prerequisite of management. Certainly by surveying the ecological condition and the effective cause on regional one can give an attentive opinion about the different aspect of medical plants efficiency [4].

The whole the total condition which explain the reciprocal relationship between the plant and the environment are the ecological demands of the plant. Every plant is need of especial growth conditions according to the existing actions [5]. Thus by studying the existing relationship between soil, plant and environmental factors, are can obtain and use the characteristics of each of them in order to manage correctly and according to ecological bases. Basically the potential breeding ground is local which according to

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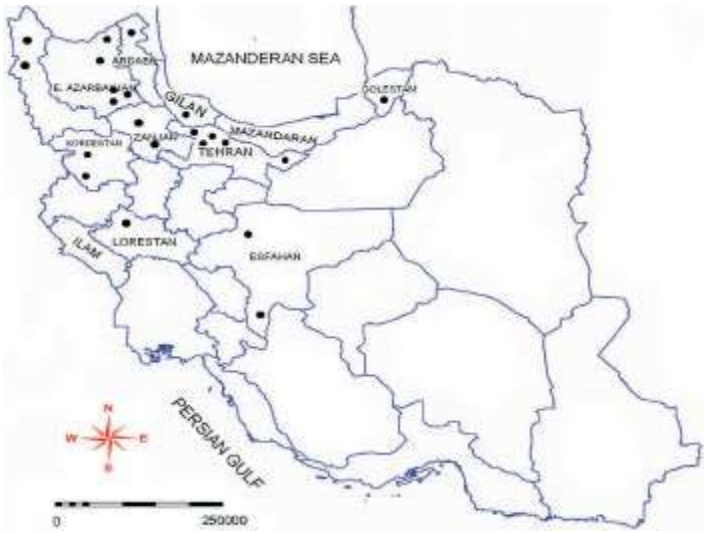

Fig. 1: Geographical distribution of this type of species in Iran

physical, chemical and biological condition create the possibility of growth and establishment for the species of plants [2,3,5-8].

The objective of such study is to find the İnteractions of relationships between the soil factor and the *T. kotschyanus* essential oil composition.

Historical Background of Study: Up to now different various researches on the study and analysis of the Essential oil of different species of *Thymus* all over the world and in Iran has been carried out. Sefidkon *et al*. in [9], during two separate studies investigated the Essential oil of the species of *T. pubescens* and found out that such Essential oil contains Carvacrol, Timol, Gamatripnan, Parasimon and Borneon [9]. During two separate investigations of Sefidkon [10] and Rustaiyan *et al*. [11] on the Essential oil of *T. kotschyanus*, it revealed that the above mentioned Essential oil mainly contains cervacrole, Timol, gamaterpinon, parasimon, Alpha-pinene, Alpha Terpineol and borneon [10,11]. During the study by Miguel *et al*. [12] on *T. kotschyanus* during two stages of day time and flowering time, discovered that there is a significant difference between the amount and compounds of Essential Oil in the leaf and flowers [12].

Morteza-Semnani and Rostami [13] investigated essential oil composition of the aerial parts of *T. kotschyanus*, collected during the full flowering period from the suburb of Behshar (north of Iran) were isolated by hydro distillation and analyzed by GC and GC/MS. The major components of *T. kotschyanus* oil were pulegone, isomenthone, Timol, 1.8-cineole, piperitenone and carvacrol [13].

EL- Ghareeb and Shabana [14] have investigated the relationship between the plant coverage and the environmental factors. To analyses the data, they used the RDA, categorize method. At the end of the research, they divided the effective factors on growth and establishment of plant species in to two groups. The first group included factors identifying the amount of humidity of soil and the second group was the fertility factors of soil. According to the data obtained they could study how the above mentioned factors can affect the plan development of one region [14].

Amiri and Saadatfar [3] using ordination method for finding the effect of important variables on *Astragalus parrawinus* species quantitative and qualitative changes. The results of this research show that there is meaningful correlation between density and cover percentage with soil factors. The results also implicate that C/N factor in A horizon and SAR in B horizon have the most effect on *Astragalus parrawinus* density and cover percentage. EC, pH and etc. factors don't have much effect on *Astragalus parrawinus* species characteristics [3].

Botanical Characteristics: *T. kotschyanus* belongs to the family of LABIATEA and it is a perennial plant. It grows up to 20cm of height. On the small wooden branches, dark green sharp and pointy leaves grow. The aromatic leaves are used as spice and medicine. The whit flowers are scented. The demonic of *T. kotschyanus* in Iran is very vast and it is often seen in mountainous regions [15-17]. In Figure (1) the geographical expansion of this type of species of Iran is shown.

MATERIALS AND METHODS

Study Area: The local and natural situation of the area under the research was mountainous with acute rocky slopes. The area under research is situated in the Damavand region the area on the total area of the expansion is 3350.4 hectares. The maximum high of the area intended is 3410 meters and at least 2300 meters in high above the sea level. The total slop of the area is more area under investigation is from 52° 8' 20" to 52º 13' 00" of latitude from 35º 41' 21" to 35º 43' 53". The average precipitation during 15 year period of Damavand regain from (1992-2007) is 482.3 mm. To carry out the research first the intended area in Tehran province (area below tarr lake) was selected [7].

Sampling Methods: A quantitative survey of the vegetation is carried out during 2006–2007. Considering the conditions of plant development of the area to measure and estimate the intended parameters such as density production, percentage of crown coverage, height of plant, the measurement of the big diameter and repetition of plotting method was implemented. In every level of altitude, two 50 meter transects were made along and perpendicular with the two transects. Samples number was determined for each site using the following equation (1):

$$N = \frac{t \times s}{(x \times k)} \quad (1)$$

Were:
N: number of essential samples,
T: t student value with n-1
∞ = 5%,
S: standard Deviation,
X: mean vegetation cover,
N: primary sample number,
K: Precision coefficient (10%) [18].

Sampling method was randomized systematically. According to equation 1, in each sites sampling was done in 6 transect and 60 plots were made. Method of sampling was randomized- systematic. The measurement of production was carried out by cut and weigh.

Quadrate samples of one square meter ($1m^2$) were used [19] to measure population, density, production, frequency, covering crown percentage, plant height major and minor diameters measurement the plot diagram was used of *T. kotschyanus* were recorded using ordinal scale of Van-der- Maabel [20]. The study of the soil is made by taking 15 profiles from the base of the plants. All the soil samples were carried to the laboratory in separate plastic bags. Measured organic carbon were determined by drying and ignition at 600°C for 3h [21] and total $Caco_3$ by Collin's calcimeter, pH in saturation extract (determined by pH meter), electrical conductivity (EC) (determined by conductivity meter), nitrogen (determined by titration with $AgNO_3$) and soluble sodium and potassium (determined by flame photometry method) [22]. Soil texture was measured by hydrometric method [23]. Sodium absorption ratio (SAR) was calculated by the following equation (2) [24, 25]:

$$SAR = Na \Big/ [(Ca + Mg)\Big/2]^{1/2} \quad (2)$$

To carry out the phyotochemistry tests, the amount of Essential oil and the existing components were analyzed with 9 times repetitions in the research Center of Herbal Remedies and Pharmaceutical plants of Tehran Medical Sciences. The main effective substances were Carvacrol and Timol [13] the samples were taken during the flowering stage and then after desiccation the Clevenger machine was used (distillation by water and steam) over 2 hours in order to extract the Essential oil. Later it was dehydrated by Sodium Sulphate to analyze and identify the compounds, the average of Gas chromatography and GC attached to Mass spectrum was used (GC/MS) [26].

Data Analysis Methods: To break down and analyze the data obtained, the multivariable regression method was used. The aim of multivariable regression analysis is to identify the connection between the variables by matching the functions with the collection of data. By considering X1, X2, X3,…Xr as the independent variables and Y as the dependent variable, the total model of function that shows the relationship between independent variables and the dependent variable is:

$$Y = \beta 0 + \beta 1 X1 + \ldots + \beta r\, Xr + \varepsilon \quad (3)$$

Parameter β_0 shows a constant amount. Parameter for and j = 1, 2, 3 is the amount of change in the amount changed in the answer when X_{ij} is one unit increase and the rest of quantities are constant. To analyze the data Minitab13 software was used. To make the data normal Sterling-Darling method was utilized. The study of the relationship between environmental variables and the plant of the indicated species is carried out with the

Essential oil of the species by the multivariable and stepwise regression analysis. The obtained data were subjected to statistical analyses according to Snedecor and Cochran using LSD at the level of 5% [22]. Data matrix of environmental factors, chemical components and *T. kotschyanus* characteristic was made. The relationship among all measured edaphic and chemical components attributes with *T. kotschyanus* establishment and distribution was explained by normal ordination grouping of RDA categories using CANOCO software [27,28]. RDA is the new technique that selects the linear combination of environmental variables that maximizes the description of the species scores. On the other hand, RDA chooses the best weights for the environmental variables [29]. This gives the first RDA axis. In RDA, composite gradients are linear combinations of environmental variables, giving a much simpler analysis and the non-linearity enters the model through a unimodal model for a few composite gradients, taken care of in RDA by weighted averaging. Redundancy Detrended Analysis is easier to apply and requires less data than regression. It provides a summary of the species–environment relations [30].

RESULTS AND DISCUSSION

Essential Oil Percentage: Among the environmental factors; the altitude of the region; organic carbon percentage, potassium and pH have a linear relationship with the extract percentage of this species and about 98% of the extract are affected. Furthermore among the botanical factors; the height of plant; the percentage of the crown coverage and the average diameter of the crown coverage, 72.2% of the changes were affected.

Total Components Percentage: The factor of the dissolviable sodium and the pH has a reverse relationship with the total components percentage in a way that 64.4% of the changes of the total components percentage related to two soil factors are measured. Among the plant coverage factors, only the production rate has a linear relationship with the total components. 33.8% of the changes are related to the production rate.

Carvacrol Percentage: The altitude percentage 33.6% of the changes of Carvacrole percentage is related to this factor. By taking notice of the results of stepwise regression, among the botanical coverage factors. The height of plant has a relationship with the rate of changes of Carvacrol percentage. 16% of the changes are related to this factor.

Timol Percentage: 96% of the changes of Timol percentage is related to the altitude of the region; organic matters percentage. sodium absorption; nitrogen and the amount of calcium carbonate. Among the factors mentioned; altitude; organic matters percentage and sodium absorption have a direct linear relationship with the percentage of Timol and the amount of nitrogen and calcium carbonate have a direct linear relationship with the percentage of Timol and the amount of nitrogen and calcium carbonate have a negative linear relationship with Timol percentage. Furthermore the density of plant had a direct linear relationship with Timol; 20.2% of the change of Timol percentage is explained by this factor.

The results of the stepwise multivariable regression between the chemical compounds of *T. kotschyanus* (dependent variable) and the environmental properties and botanical coverage factor (independent variable) are mentioned in Table (1) and (2).

Table 1: The results of stepwise multivariable regressions among the chemical compounds of *T. kotschyanus* (dependent variable) and environmental characteristics (independent variable)

Chemical compound % (Y)	Environmental factor (X_1,...,X_2)	R^2	Equation
Essential oil	Reg.alt., OC, k, pH	98	Y= 128.01-0.027 Reg.alt.+ 0.99OC+ 0.082k- 12.14 pH
Total components	SAR, pH	64.6	Y= 202-79.6 SAR- 13.8 pH
Carvacrole	Reg.alt.	33.6	Y= -111.28+ 0.056 Reg.alt.
Timol	Reg.alt., OC, SAR, $Caco_3$	96	Y= -6439.2+ 2.28 Reg.alt.+ 139.9 OC+ 5583.6 SAR- 9720.6 N- 23.5 $Caco_3$

Table 2: The results of stepwise multivariable regression between chemical compounds of *T. kotschyanus* (dependent variable) and botanical factors (independent variable)

Chemical compound % (Y)	Environmental factor (X_1,...,X_2)	R^2	Equation
Essential oil	Ave-diam- Veg.cover, Pl.hei., Veg.cover	98	Y= 1.226+ 0.77 Ave-diam- Veg.cover+ 4.96 Pl.hei.+ 0.594 Veg.cover
Total components	yield	64.6	Y= 69.5+ 0.581 yield
Carvacrole	Pl.hei.	33.6	Y= 62.89- 6.128 Pl.hei.
Timol	density	96	Y= - 13.34- 33.34 density

Table 3: Simple correlation coefficient between chemical compounds and botanical parameters

	Essential oil	Total components	Carvacrole	Timol	Yield	Ave-diam-veg.cover	Pl.hei.	Veg.Cover	density
Essential oil	1.00								
Total components	-0.38	1.00							
Carvacrole	-0.34	0.57*	1.00						
Timol	-0.25	0.24	0.47	1.00					
Yield	0.10	0.53*	-0.30	0.19	1.00				
Ave-diam-veg.cover	0.53*	-0.31	-0.17	0.40	-0.45	1.00			
Pl.hei.	0.61*	-0.41	-0.64**	-0.29	0.08	0.55	1.00		
Veg.Cover	0.55*	0.41	-0.45	-0.15	0.14	-0.14	0.40	1.00	
density	0.07	0.03	-0.07	-0.61*	-0.12	-0.14	-0.15	-0.15	1.00

* Correlation is significant at the 0.05 level.

** Correlation is significant at the 0.01 level.

Table 4: Simple correlation coefficient between chemical compounds and environmental characteristics

	Essential oil	Total components	Carvacrole	Timol	Reg.alt.	OC	Na	SAR	K	N	PH	EC	$Caco_3$
Essential oil	1.00												
Total components	-0.38	1.00											
Carvacrole	-0.34	0.57*	1.00										
Timol	-0.25	0.24	0.47	1.00									
Reg.alt.	-0.6*	0.28	0.76*	0.58*	1.00								
OC	0.25	-0.23	0.22	-0.25	0.28	1.00							
Na	0.14	-0.08	-0.01	0.06	0.32	0.56*	1.00						
SAR	0.13	-0.07	0.01	0.11	0.35	0.56*	0.98**	1.00					
K	0.55*	0.14	0.27	0.27	0.08	0.09	0.15	0.14	1.00				
N	-0.11	-0.11	0.33	-0.19	0.58*	0.84**	0.68*	0.67*	0.03	1.00			
PH	-0.05	-0.21	0.37	0.15	0.10	-0.04	-0.62*	-0.62*	0.04	-0.19	1.00		
EC	0.43	-0.17	0.03	-0.32	0.03	0.88**	0.66*	0.66*	0.23	0.676*	-0.17	1.00	
$Caco_3$	-0.20	0.14	-0.43	-0.22	-0.47	-0.26	-0.22	-0.21	-0.52*	-0.44	-0.06	-0.01	1.00

* Correlation is significant at the 0.05 level.

** Correlation is significant at the 0.01 level.

To interpret the connection between the environmental characteristics and botanical parameters, the absolute number of the simple coefficient correlation between the environmental characteristics and botanical parameters between in five levels are categorized; 1) no effect (0-0, 2) less effective (0.2-0.4), 3) average effect (0.4-0.6), 4) more effective (0.6-0.8) and 5) the most effective (1-0.8). In the Tables (3 and 4) the results of the correlation between the botanical coverage parameters and the environmental factors with the chemical compounds of *T.kotschyanus* is shown. The results indicated by Table (3) reveals that the percentage of Essential oil has a significant collaboration with height, vegetation cover percentage and average diameter of vegetation cover and with the altitude of the region and the amount of potassium in earth in the area of 5%. The total compounds of *T.kotschyanus* species showed a 5% significant correlation. With none of the environmental factors showed the probable level of 1% and 5% significant correlation. Among the environmental factors and the botanical coverage studied the altitude and the height of plant showed a significant correlation with carvacrole percentage in the probable level of 5%. In addition Timol percentage had a 5% negative correlation with the density and with altitude showed 5% positive correlation.

Also the results indicated in Table (4) shows that among the environmental factors, sodium with the proportion of exchangeability of sodium and the amount of nitrogen has a positive consistency in the probable level of one. It has a 5% negative correlation with the acidity of soil. The organic matters have a positive significant correlation of 1% with the amount of nitrogen and electrical conduction. Sodium absorption had a positive significant correlation with the amount of nitrogen and the amount of nitrogen with electrical conduction had a positive correlation.

Correlation among Environmental Characteristics by RDA Method: RDA is a kind of technique that shows non-linear relations between species with environmental factors and chooses the best weights for

Table 5: Correlation coefficient between species ordination (botanical parameters) and environmental properties axis

	SP AX1	SP AX2	SP AX3	SP AX4	EN AX1	EN AX2	EN AX3	EN AX4	yield	Ave-diam -veg.cover	Pl.he.	Veg. cover	density	Reg.alt.	OC	Na	SAR	K	N	pH	EC	$CaCo_3$
SP AX1	1.00																					
SP AX2	0.001	1.00																				
SP AX3	0.004	0.001	1.00																			
SPAX4	-0.70**	0.00	0.00	1.00																		
ENAX1	1.00	0.00	0.00	-0.70**	1.00																	
ENAX2	0.00	1.00	0.00	0.00	0.00	1.00																
EN AX3	0.00	0.00	1.00	0.00	0.00	0.00	1.00															
EN AX4	0.00	0.00	0.00	0.72**	0.00	0.00	0.00	1.00														
yield	0.19	-0.48	-0.41	-0.28	0.19	-0.48	-0.41	-0.21	1.00													
Ave-diam -veg.cover	-0.70**	0.17	0.03	0.80**	-0.70**	0.16	0.03	0.45	-0.45	1.00												
Pl.he.	-0.61*	-0.42	-0.29	0.27	-0.61*	-0.42	-0.29	-0.21	0.08	0.55*	1.00											
Veg.cover	-0.15	-0.34	0.46	-0.42	-0.15	-0.34	0.46	-0.7**	0.14	-0.14	0.40	1.00										
density	-0.29	0.08	0.01	0.15	-0.29	0.08	0.01	-0.08	-0.12	-0.14	-0.15	-0.15	1.00									
Reg.alt.	0.58*	0.55*	0.11	-0.10	0.58*	0.55*	0.11	0.42	-0.35	-0.04	-0.58*	-0.45	-0.29	1.00								
OC	-0.25	0.32	-0.49	0.33	-0.25	0.32	-0.49	0.23	-0.10	0.28	0.11	-0.40	-0.26	0.28	1.00							
Na	0.06	-0.06	-0.15	-0.06	0.06	-0.06	-0.15	-0.03	0.25	0.13	0.28	0.23	-0.63*	0.32	0.56*	1.00						
SAR	0.11	-0.06	-0.15	-0.09	0.11	-0.06	-0.15	-0.03	0.25	0.09	0.25	0.21	-0.65**	0.35	0.56*	1.00	1.00					
K	0.27	0.12	-0.55*	-0.53*	0.27	0.12	-0.56*	-0.47	0.27	-0.46	0.04	0.00	0.35	0.08	0.09	0.15	0.14	1.00				
N	-0.19	0.44	-0.21	0.42	-0.19	0.44	-0.21	0.40	-0.28	0.50	0.09	-0.35	-0.31	0.58*	0.84**	0.68**	0.68**	0.03	1.00			
pH	0.15	0.28	-0.33	0.20	0.15	0.28	-0.33	0.43	0.10	-0.17	-0.55*	-0.8**	0.45	0.10	-0.04	-0.62*	-0.62*	0.04	-0.19	1.00		
EC	-0.32	0.16	-0.47	0.18	-0.32	0.15	-0.47	-0.06	0.26	0.09	0.19	-0.09	-0.17	0.03	0.88**	0.66**	0.66**	0.23	0.68**	-0.17	1.00	
$CaCo_3$	-0.22	-0.30	0.55*	0.03	-0.22	-0.30	0.55*	-0.18	0.21	-0.26	-0.21	0.41	0.11	-0.47	-0.26	-0.22	-0.21	-0.5	-0.44	-0.06	-0.01	1.00

* Correlation is significant at the 0.05 level.

** Correlation is significant at the 0.01 level.

For sites abbreviations and soil characteristics units, see Appendix.

Table 6: Eigen values for each axis in RDA method

	Axis 1	Axis 2	Axis 3	Axis 4
Eigenvalues	0.998	0.001	0.00	0.00
% of variance explained	99.8	0.2	0.00	0.00
Cumulative % explained	99.8	100	0.00	0.00

environmental variables. The analysis of variance showed that there was a significant correlation among species (botanical parameters) and the environment axis in the levels of and 5%. Taking samples from 15 study sites provides at least 15 values for each soil character. The t value (correlation index, the degree of freedom was 14) among the soil and vegetation cover characteristics was calculated using the following equation (4).

$$t = r[(n-2)/(1-r^2)]^{1/2} \quad (4)$$

Were: r: correlation coefficient, n: samples number, t: correlation index. Only t values of -0.64% ≤ r ≤ + 0.64% at 1% probability level and –0.5% ≤ r ≤ +0.5% at 5% probability levels were significant according to the t student Table (5). There was a strong and significant correlation between the first axis of soil with the first axis of plant characteristics (r =1). The same correlation was calculated between the second axis of plant and soil characteristics (r =0.97). The correlation coefficient between species, ordination and soil properties axis show in Table 6. Notably in Table (5) the first axis of botanical parameters has a very high correlation with the first axis of the environmental features (r=1). The Eigen value of the axes in Table (6) indicates that the first axis, 99.8% and the second axis 0.2% of the variance of the parameters of species and to the area are 1,5 and 5% with average diameter of the covering crown, the height of plant and the altitude with significant correlation. The second axis is about the botanic parameters in level 5% with the altitude. the third axis of the botanical parameters in level of 5% with the amount of potassium and calcium carbonata of soil, the fourth axis of botanical parameters in the level of 1% with average diameter of the covering crown and in level 5% with potassium of soil have significant correlation between the first of environmental parameters is significant with the diameter of covering crown the height of plant and the altitude respectively in levels 1,5,5% the correlation between the second axis of environmental parameters with altitude,the thirst axis of the environmental parameters with amount of potassium and the fourth axis environmental parameters with crown coverage percentage in level of 5% is significant. Among the botanical parameters the relationship between the

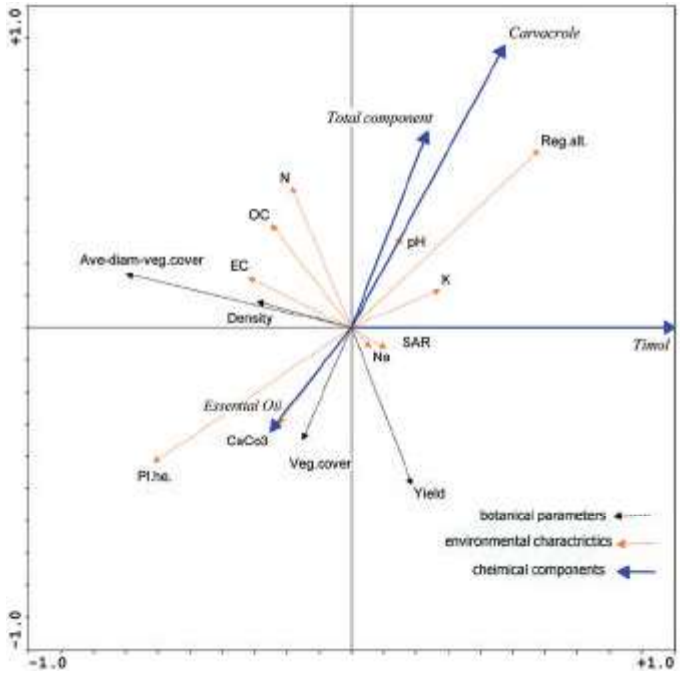

Fig. 2: The relationship between environmental characteristics, botanical parameters and chemical components of *T. kotschyanus* obtain by RDA method. 6.

height of plant and the diameter of covering crown, the height of plant and the percentage of covering crown with the acidity of soil, the population density of plant with the amount of sodium and proportion of sodium in take, the nitrogen of soil with the altitude and electrical conduction and calcium carbonate with the amount of potassium in the soil in cover of 5% is significant.

Analysis of Plant Parameters and Environmental Characteristics Relationship with Chemical Components by RDA Method: In Fig.2 the resultant of botanical parameters and the environment characteristics by RDA technique reveals and relationship between the changes of environmental characteristics and botanical parameters is shown by graphical interpretation. Notes must be taken into accounts that in the analysis the results of the analysis by RDA the parameters have no coefficient. Their significance and how they affect on the other parameter depends on the length of the arrow. The longest arrow positive and the shortest arrow has the least effect capacitive negative. The two synchronized arrow has the least effect positive effect and two arrows in appositive direction with max 180 angel show that there is a negative effect of the two parameters. the result of the botanical parameters and the environmental features analysis by RDA technique (Fig.2) shows that by increasing the crown coverage percentage and the height of plants, the Essential oil percentage of *T. kotschyanus* species increases and a many the altitude of the region by the increase of the altitude the percentage of the Essential oil decreases, the increase of the density and the diameter of the covering crown decrease the percentage of Timol. The total percentage of the botanical compounds increases as the altitude increases, also the total percentage of the compounding increases but this relationship with calcium carbonate is negative. The percentage of carvacrole of plant increase with the altitude. The relationship between carvacrole and the acidity, potassium and sodium and the sodium absorption ratio of soil is a positive relation. The percentage of Timol in plants decreases as the diameter of covering crown and density increases. The percentage of Timol in plants has a positive relation with sodium absorption ratio of soil. As the density of plants increases the production rate decreases. The production rate has a negative and decreasing relationship with nitrogen.

DISCUSSION AND CONCLUSION

The settlement of such species is mainly in clay soil rather than loamy sandy soils. The mountainous lands have very shallow up to deep soil and in some areas it is

deep with pebbles and pieces of rocks. Especially in the height of 2800 meter the land is mainly rocky. The amount of organic matters very between 3 to 6.9%. The amount of $Caco_3$ changes from 0 to 19.58 and this haws that the species under study has the capability to grow and establish in the soil with or without lime. The correlation relations and the regression show that any species regarding the regain of growth, the ecological needs and its tolerance, have the link with the environmental features and these lineless or relationships differs for every species. However, regarding the relationships and the regression coefficient obtained, it is evident that the environmental factors of pH, SAR, $Caco_3$ and from the plant coverage factors, the height covering crown percentage, the average diameter of covering crown, production rate and density have the most relationship in the changes of effective chemical matters in *T. kotschyanus*.

The results of the multivariable regression and RDA method reveals that the Essential oil percentage of such plant has a relationship with organic matters, potassium and electrical conduct of soil and the regional altitude and its height of plant, crown percentage and craw diameter. There fore the Essential oil percentage of the species pound in salty soils is very low and as the covering crow percentage and the height of plant increase, the percentage of Essential oil increases as well, the Timol percentage of such species has a direct relationship with $Caco_3$, SAR and N of soil, the altitude and the density of species. Mashaly [31] used CCA method for investigation relationships between vegetation and soil in Lake Borollus protected area. The Canonical Correspondence Analysis indicated that, the most effective soil variables controlling distribution and abundance of the identified vegetation groups are soil texture (clay & sand), moisture content, porosity, potassium, sodium and calcium cations, organic matter, calcium carbonate, electrical conductivity, sulphate and bicarbonate [31].

Also, this study shows that the Timol percentage of those species which grow in calcic soils and also those growing in high altitudes is more and in those regions that the density increases the percentage of Timol decreases. The percentage of carvacrole only changes as the altitude of the area changes. There fore carvacrole percentage of those species that grows in low altitude soils, decreases. Finally the total percentage of *T. kotschyanus* compounds has a fevers relation with SAR and pH factor of it's soil and with the production rate, it has a direct relationship like the factors mentioned above it shows that the effective chemical substances of such species in salty and alkaline soils is less. The result of this research isn't similar of Habibi *et al*. [32]. The results investigated of Habibi *et al*. [32] indicated that the pH adjustment had a significant effect on *Mozzarella cheese* yield [32].

By getting inspiration and studying ecological breeding ground each of the species of plants, one can multiply them in vast scale. The basis of any research activity about the species of plants is about accurate identification of plants and also about autecology's conditions dominated by such plants. With such purpose the autecological plan of Iran is the first step which can have a fundamental rate in determining the suitable research based grounds. By acting correctly and wisely one can assist in better recognition of the plants in various aspects and understand their medical, industrial and feeding usage and hence creates the causes of the economical development of one's country.

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Appendix: Units and abbreviations of the plant species and environmental characteristics in the figures and tables.

Thymus kotschyanus	*T. kotschyanus*
Eigenvalues	Eign.
Average-diameter of vegetation cover	Ave-diam- veg.cover
Plant height	Pl.hei.
vegetation cover	Veg. cover
Regional altitude	Reg.alt.
Sodium absorption ratio	SAR
Organic carbon (%)	OC
pH (acidity)	pH
Electrical conductivity (dS m^{-1})	EC
Sodium ion (Na^+) (meq L^{-1})	Na
Nitrogen	N
Potassium (K^+) (meq L^{-1})	K
Calcium carbonate (%)	$Caco_3$
Species $Axis_{1,2...n}$	SP $AX_{1,2...n}$
Environment $Axis_{1,2...n}$	EN $AX_{1,2...n}$