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Aspects of the autecology of arta (*Calligonum comosum* L. Her) a medical plant from arid region of Saudi Arabia

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Abstract

This study is to investigate the aspects of the autecology of *Calligonum comosum* plant. This plant species is one of the famous pastoral plant characterizing the habitat of Saudi Arabia. The *C. comosum* plant is belonging to the botanical family polygonaceae, plant is frequently used as sources of medicine by rural people. The study site was located in the north-east of Riyadh city, in "Dahna" area. The results showed that *C. comosum* is dominant plant in the area, 23 plant species were recorded in the study site, belonging to 16 families, they contain 11 perennial types and 12 annuals types, and the *C. comosum* is important companion plant. *C. comosum* is perennial shrubs, branched from the base to height of 100 to 200 cm. The fruits are spherical shape with a thick and long hair its color from yellow to red, this plant is characterized by pure pungent smell and excessive rigidity because it is config.d solid wood. The life cycle of *C. comosum* is regular for perennial plants, started grow from the seeds after the seasonal rains during November, the flowers and composition of fruits started at March, the production cycle of this plant is about 4 months. The electrical conductivity (EC) of the soil was ranged from 6.4 to 6.7 dS m^{-1} and the concentration of SO_4 and Fe relatively high. The plant accumulates high content of Mg, Si, Cl and K in their tissues.

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Introduction

Calligonum comosum is a small leafless shrub, which has reputation in folklore medicine as a stimulant and astringent, under the local names "ghardaq", "rusah" or "arta". It is naturally and widely spread in different areas of Saudi Arabia. *C. comosum* is an arid regions plant used in treat rural population microbial infections. Also, has economic and pastoral value, in addition to has a major role in stabilizing the sand. Indeed, studies have been reported the effects of *C. comosum* on medical benefit; skin diseases, antimicrobial agents, anti-inflammatory, anti-ulcer and anti-cancer activities (Liu *et al.* 2001; Riadh *et al.* 2011; Badria *et al.* 2007). Moreover, *C. comosum* has an effective influence against diabetes at the same time there is some chemicals may have a catalytic effect for some types of cancers (such as the bowel, bladder and liver cancer). Also the red veins and branches used in dyeing in leather tanning, furthermore is a source of energy for both human and animal because its abundance of sugars and nitrogen. The Family of *C. comosum* is (Polygonaceae) is called an acid family, all *C. comosum* plant parts contains flavoandhat and alkaloids and turbines triple antrakinont materials and kumarinat. The department of pharmacognosy, faculty of pharmacy separated many flavondah components such as kambeverol compounds orstein, aazhukhoarestren, procyanidin, vaio xantin new oxantin. It also contains saponaria materials and has a viscous liquid accumulates under the plant in the form of honey-like substance with a brown color to the scarlet and used to treat cough, add to food for a nice smell and is a major source of protein. The *C. comosum* plant spreads in sandy environments and crevices and assume high degree of salinity (Zoghet and Al-Alsheikh 1999), there are two types of plant in the eastern area of the Kingdom of Saudi Arabia, the *C. comosum* L، Her and *C. crintum* Boiss, The *comosum* exists in abundance in the veins and cracks, especially west Fadhli areas and veins of "Alharari" and north "Dahna". It is located in west of the study area or "Dahna Nafud", it is a small sandy desert "Nafud" extending from the arc to the east of "Najd" direction, which extends to the Empty Quarter desert. Specifically northeast Riyadh in the direction of the Dammam city on after 112 km, and this region is characterized by red as a result of the presence of iron oxides in the sands and the lack of calcium carbonate (Mandaville 1990). An asterisk moving sand dunes, and this region prevails continental climate is characterized by drought and lack of rain, the average temperature between 49 –49.9 °C. The rain is few and irregular, where several months pass without falling rain. The highest annual rate of rainfall reached 124.38 mm in the study area, over the past ten years, and falls mostly between October very small quantities and will continue to fall, a slight increase in November and rise in January and then return to decline thereafter rises until it reaches its highest value in March The highest rate of up to 75% moisture in the month of January, and the rate of the wind speed was changeable where the most wind speed was in the period from November to August, with an average wind speed in the month of July and June to 9 km/h. The vegetation was few in the study area because of the lack of rain and high temperature and soil quality, vegetation in the sandy soils of low-density sparse and limited to some plant species with a huge root therefore; the objective of current study was to investigate the aspects of the autecology of *Calligonum comosum* plant system.

Materials and methods

Field studies

Do investigative trips in Dahna area northeast of Riyadh city, Saudi Arabia. It was found that of *C. comosum* is spread in many locations within the region. Having been in field follow-up of plant growth regularly (twice each month) for a full year to record the changes, times of flowering, fruiting and collected the companion plant with it throughout the year. In the field, some preliminary measurements on *C. comosum* plants have been measured until the growth is complete (when fruit ripening and before it) such as plant height, crown width, leaf area, root depth, flowering and seed collection. Soil, leaves,

shoot and roots samples were collected and subjected to chemical analysis.

Laboratory Studies

Plant classification

In the laboratory, preparation samples of plant species have been deposited in the herbarium of the department of biology Princess Noura Bint Abdul Rahman University. And has been identified with existing herbarium samples in this herbarium and use some of the references in specialized taxonomic evidence to the flora of Saudi Arabia (Collenette 1999).

Quantitative estimation

Collected samples of *C. comosum* plant (leaves, stems and roots) dried in a oven at a temperature of 75°C and then grind to powder and analyzed for organic carbon (Allen *et al.* 1979), total Nitrogen (Delory 1949), phosphorus (Woods and Mellon 1941). The plant samples were digested using $HClO_4$ and H_2SO_4 (Humphries 1956). Finally, the K, Ca, Mg, Na and Fe levels were determined using Atomic Spectrometer. In addition, Cl^- was measured (Jackson and Thomas 1960). The soil samples were passed on a sieve 2 mm to exclude gravel and suspended solids after drying, and then analyzed for soil texture, pH and EC. Five replicates for each sample of the previous measurements and a variation of a one-way and two-way analysis has been estimated the significant differences at 1.0 % level.

Results

Description of study site

The study area is located in the eastern region of Saudi Arabia, which is far from the Riyadh city by about 100 km. Riyadh city located in Najd plateau in the central region of the Kingdom of Saudi Arabia, which is located within the dry desert belt of western continents, central region continental climate characterized by drought and lack of rain. This area also lacks the seas and lakes which affects the temperature and humidity of the atmosphere. For the topography, there is a height mountainous (Tuwaiq Mountains) and high land above sea level in addition to its surrounded by desert from all directions. The *C. comosum* is the perennial prevailing plant in this site the other perennial species of plants is few and sparse. However *C. comosum* plant grows in many groups converged or dispersed along this site. Have been recorded eleven perennial plant species in addition to twelve annuals plants growing an accompanying in the region. Table (1) shows only one plant is (Ephedra alata) follows the gymnosperms while the rest of the species belonging to the angiosperms. Six types of them belonging to monocots, four is annuals types and two is perennial type.

Table 1. Plant species recorded in the study area, life cycle and taxonomic status.

Class	Subclass	Order	Family	Life cycle	Species
Gymnospermae		Gnetales	Ephedraceae	Perennial	*Ephedra alata* Dence
Angiospermae	Dicotyledoneae	Geraniales	Capparaceae	Perennial	*Capparis decidua* (Forssk) Edgew
			Cleomaceae	Perennial	*Cleome arabica* L.
				Perennial	*Dipterygium glaucum* Decne
			Cruciferae	Annuals	*Eremobium lineare* (Del.) Asch et Schweinf
			Geraniaceae	Perennial	*Erodium gleurocophyllum* (L.) Aiten
			Zygophyllacea	Annuals	*Tribulus lonbipetalus* Viv
		Centrospermae	Caryophllaceae	Annuals	*Polycarpaea repens* (Forssk.) Asch. & Schweinf
				Annuals	*Silene arabica* Boiss
		Rosales	Leguminosae	Perennial	*Medicago*

Class	Subclass	Order	Family	Life cycle	Species
					aschersoniana Urb.
		Tubiflorae	Convolvulacea	Perennial	*Convolvulus lanatus* Vahl.
			Boraginaceae	Perennial	*Heliotropium bacciferum* Forssk.
		Plantaginales	Plantaginaceae	Annuals	*Plantago ovate* Forssk.
				Perennial	*Artemisia abyssinica* Sch. Bip
		Campanulales	Compositae	Perennial	*Rhanterium epaposum* Oliv.
				Annuals	*Launaea cassiniana* (jaub.&Sp.)Kuntze
		Rosales	Neuradaceae	Annuals	*Neurada procumbens* L.
		Liliflorae	Liliaceae	Perennial	*Asphodelus fistulous* L. V tenuifolia Cav.
				Annuals	*Dactyloctenium aegyptium* (L.)P. Beauv.
	Monocotyledoneae	Graminales	Graminaea	Perennial	*Eleusine compressa* (Foessk.) Asch & Schweinf Ex Christens
				Perennial	*Panicum turgidum* (Forssk.)
				Annuals	*Tragus racemosus* (L.) All.
		Cyperales	Cyperaceae	Annuals	*Cyperus conglomerates* Rottb.

Table 2. Some physical and chemical characteristics of soil used.

Depth	Available nutrients (ppm)												Particle size distribution (%)		
	pH	EC (dS m^{-1})	$CaCO_3$ (%)	O.M (%)	K	Na	Fe	Mg	Cl	Mn	SO_4	PO_4	Sand	Silt	Clay
0-10 cm	7.55	6.40	2.67	0.10	4.5	25	0.45	7.4	26	7.5	7.7	6.6	95	2	3
10-35 cm	7.60	6.60	2.50	0.10	5.2	20	0.42	6.5	23	7.4	9.6	6.6	94	2	3.7
35-60 cm	7.90	6.70	1.80	0.10	4.0	18	0.26	5.8	17	7.3	8.2	6.1	95	2	3

(ppm) part per million; (O.M) organic matter; (EC) electrical conductivity.

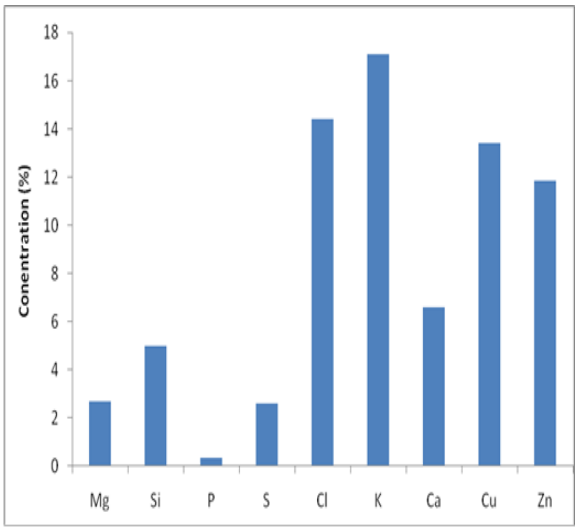

Fig. 1. Shows the percentages of mineral elements in the shoot of C. comosum plant.

Plant description

The type *C. comosum* plant (Image 1) considered perennial shrubs with wooden stems green in the early stages to turn gray in the old branch. Table (3) shows some taxonomic traits studied about *C. comosum* plant. Its length ranging between 1-2 meters, many forking with bloated nodes, non leaves or a very small leaves rapid precipitation and huge roots up to 30 meters depth. With white flowers or yellow or sometimes red (Image 2), with five white floral cover and veined red. The pollen consists of eight to ten stamen relatively long filaments of up to 3 mm and this is in agreements with (Zoghet and Al-Alsheikh 1999). The anther connected to the long filaments connected baseline with two lobes, and

bloom through long cracks in the front wall of the ovary and the anther with irregular superficial cells form of external walls zigzagging, with wide and long filaments. The fruits are spherical with a thick and long hair shape, its color between yellow and red (Image 2), and the *C. comosum* fruit type is (Akin). Where the fruits wall was adhesion with seed wall so it was difficult to separate the seed from the fruit. And the color of the *C. comosum* fruits often red (Image 2), Oval-shaped tend to elongation its length from 0.7 cm to 1.3 cm with cross-section quatrefoil. Between every two lobes There longitudinal line covered with dense hairs give the fruits of spherical shape sometimes. Straight lines in modern fruits and take in torsion whenever it grew fruit age. This plant is characterized by pure pungent smell and extra rigidity because it is config.d of solid wood.

Image 1. *C. comosum* plant in the study site.

Image 2. Flowers of *C. comosum* plant.

Table 3. Some measurements of taxonomic traits for *C. comosum* at the end of the growing season.

Trait	Min-Max
Plant length(cm)	90-140 126.3 cm
Plant width (cm)	170-365 299 cm
Stem color	Old stem wooden with a gray color and new stem green
Length of the internodes	2-4.5 3.28 cm
The amount of swelling of nodes	0.3-1.6 0.675 cm
Flowering period	First March
Fruiting period	Mid-March
The color of the fruit	With red color and a few of them a yellow color
Length of the fruit	0.7-1.3 1.01 cm
Length of filaments on fruits	0.1-0.25 0.17 cm
cuticle on the external walls of the cells of filaments in the fruit	Not clear
Abundance of wax secretions on the fruit	Thick
Length of pollen	31-36.2 19.5 µm
Width of pollen	18.2-21.1 19.5 µm
Length of germination hole	29.7- 34.1 32.6 µm

Phonological manifestations

Means the emergence of dynamic changes in different seasons of the year, *C. comosum* plant considered of evergreen shrubs task however falling leaves in large quantities and possibly dry branches or whole plant when drought or other factors. Through monthly visits and follow-up during the previous study period identified, it was found that this plant starts in vegetative growth after rainfall (the end of the autumn and early winter), the months of November and December and January, and have flowers in early March and fruits is made up after about 10-15 days.

Plant analysis

Fig. 1 shows the percentage of Mg of the *C. comosum* plant was high 7.03%, and Si was 4.99% and P 2.06% and this result is expected due to the lack of plants in general in the study area. Sulfur concentration 6.04%, the Cl^- content increased reaching 14.41%, K was 37.1%, and the Ca 6.59%. The proportion of Cu was

high 13.4%, and the Zn was 11.83%. These findings are agreed well with (El-Moneyeri *et al.*1986).

Soil analysis

Table (2) shows that the sand ratio averaged 94.5% which indicated that the soil texture is sandy, the percentage of silt and clay was very low and does not exceed 7 %. Results showed that the pH is neutral soils tend to be alkaline, the EC of the soil solution was low about (6.4) dS m^{-1} in the surface layer and (6.6) ds m^{-1} in the second depth and then reached the depth (6.7) dS m^{-1} in the last depth. The results in Table (2) indicated that the low $CaCO_3$ content which decreased with the soil depth in the soil where they reached the proportion of $CaCO_3$ to 2.67% in the surface layer and less to1.83% in third depth (35-60 cm. The K content was low and increasing with increasing soil depth, and reached the highest value at the second depth (52) ppm. The Na was low and increased slightly, the highest content (20 ppm) in second depth. The highest rate of the Fe was found in the surface soil layer, Mg varied from 5.8 ppm in third depth to 7.4 ppm compared to surface soil layer. Table (2) shows that the Cl^- concentration was generally low in the soil, in the surface soil layer.

Discussion

In this study, specific aspects of self-environment to *C. comosum* which is considered a high-value pastoral plants, which was spread widely in the sandy desert of Saudi Arabia. In with the very need for feed and fuel and misuse of man to this plant, where they burned to be used for heating beside overgrazing attic, has been eliminated (25%) of its bushes. With this in mind and try the best conditions for the propagation of these plant environmental conditions of work and to learn more of the attributes of taxonomic and adaptive the study done, was chosen area where clan prevail *Calligonum comosum* is Dahna desert. The study area is characterized by sandy soils, with a little salt content and their lack of vegetation and even scarcity, advantage of the strength of soft, sandy, the homogeneity of granules, the lack of salinity, depth, with a weak ability to retain water, susceptible to wind erosion, and the ground level where deep. According to (Shaltout *et al.*1996) the soil salinity rises in protected areas of grazing, and desert Dahna is more likely to graze. It is observed that the climate and soil properties influence on the nature of the vegetation, intensity and quality. It has been found from the daily observations that the plant growth of the seed is very weak, and this is due to the quality of the seeds of this plant, where the fruits type is “Achene”. Where the fruits wall attached to the wall of the seed, and so it was difficult to separate the seed from the fruit. So for the germination of fruit that contains the seed must be removing the hairs on it, as well as the nature of the harsh desert environments. Growing *C. comosum* plant in the soil overcome them coarse-grained (coarse sand and fine sand) its percentage (95%), and tiny soil fractions (silt and clay) its percentage (5%).The soil pH ranged between from 7.5 to 7.9. It also found that the amount of dissolved salts is high and therefore increased electrical connectivity. For the vegetation study, it found that (11) perennial plants and (12) annuals plants Table (1). This number of plant species is too low and could be attributed due to the environmental factors such as soil and climate chanes (Abbas *et al.*1991; Whittaker 1972; El-Demerdash *et al.* 1995; Shaltout *et al.*1997; Organgi 1982; Organgi 1985). *C. comosum* is a perennial plants start grow from the seeds to vegetative growth after heavy rains (the end of the autumn and early winter), the months of November and December and January, and have flowers in early March and composition of fruits after about 10-15 days. Thus, the production cycle of this plant is about 4 months and these are the normal and regular life cycle of *C. comosum* plant. The plant may use low moisture from the soil and some suitable environmental factors such as (low temperature) for a short period for flowering and fruiting. *C. comosum* plant is branching from the bottom of the plant, where the branches grows to different distances above the surface of the soil, plant stems is green wooden in the early stages and turns to gray in the old branches, the old branches height on average to meter to two

meters with nodes (Collenette 1999; Zoghet and Al-Alsheikh 1999). Colorless leaves or a very small leaves and is falling rapidly (Mandaville 1990). The flowers are white or yellow or red in some cases. The fruits spherical shape with a thick and long hair, fruit color from yellow to red, the plant has a pungent smell, rigidity to be config.d solid wood. Environmental pressure encountered by the *C. comosum* plant have strong impact on the vegetative taxonomic characteristics, where the roots extend to great depths up to 30 m into the soil to reach ground water, and the hardness of wooden stem and falling leaves in order to avoid dehydration. The fruits have a red color due to soil containing a high content of iron oxides. The results of elemental analysis Table (3) indicated that K accounted for the largest element adapt to dry environment. The rest of the elements (P, Ca, Si and Mg) were in low concentrations. Finally, through this study, we find that the *C. comosum* could grow and adapt in the presence of stress environmental conditions, such as the lack of water, and increase the higher soil concentration.

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