

## The Influence of edaphic factors on the level of some physiological parameters for *Lycium shawii* in Taba Protected Area, Egypt.

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**Abstract:** The aim of this article is assess the influence of environmental factors (especially edaphic) on the level of some physiological characteristics of plant communities in Taba Protected Area (Taba PA), South Sinai region. The Taba Protected Area (TPA) is one of Egypt's largest protected, about 2850 km<sup>2</sup> (Lat. 29° 32' N, Long. 34° 46' E, Alt. 500 m a.s.l.), In International Protection Category III (In accordance with IUCN). Results showed that edaphic factors have an important role at variation in biochemical contents of plant communities within the selected wadis. The soils of study area, as desert soils (Arid soils), where soil properties vary over quite small distances, the causes of this variation due to some environmental factors such as gradient on the elevation, temperature, and rainfall between different locations. Four samples of *Lycium shawii* were collected from four studied locations. Evaluation of present methods used for analyzing the major biochemical contents (Soluble Carbohydrate, Water Soluble protein, Proline and Photosynthetic Pigments). Results were statistically analyzed by using One-way ANOVA and Post hoc-LSD tests (the least significant difference). In this study, prominent variation was recorded as regards the biochemical constituents of the plant among the different wadis.

**Keywords:** Edaphic factors, *Lycium shawii*, Taba PA.

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### I. Introduction

Edaphology is the study of influence of soils on plants and other living things. The Edaphic or Soil Factor is important because of the intimacy of contact between the plant and soil through the root system, and that both the plant and soil are strongly influenced by each other. Physical, chemical and biological interactions that occur between plants and the surrounding environment of the soil are the most complex experienced by land plants (Powelson et al., 2011).

Soils of South Sinai, as desert soils (Arid soils), are characterized by spatial heterogeneity, where soil properties vary over quite small distances. The causes of this heterogeneity include variation in plant cover, vegetation composition, slope, and topography. (Schlesinger et al., 1996 and Moustafa and Zayed, 1996), show that soils of the South Sinai are gravelly in wadis and plains, rocky at mountains in surface, sand to loamy sand in texture, alkaline, non-saline to slightly saline. They are characterized by low content of essential nutrients and CEC.

Soils of mountainous landforms are shallow in depth but rich in silt and clay, and different soil nutrients, (Kassas, 1952) of rough sand texture, which characterized by low content of organic matter, and poorness of many essential soil nutrients such as N, P, and K (Balba, 1995). Soil pH, EC, silt and clay content are the most important indicators of soil quality, and represent driving variables in the soil system, influencing the availability of soil nutrients and controlling the coverage and structure of vegetation.

Environment inadequate conditions promoted by abiotic factors such as water, temperature, salt, and mineral elements can provoke reductions in growth and development in plants, disorders in physiological, biochemical, and molecular behaviors, besides yield losses in several crops (Tan et al., 1999; and Oliveira et al., 2009a). As a consequence, inhibition of photosynthesis, metabolic dysfunction, and damage of cellular structures contribute to growth perturbances, reduced fertility, and premature senescence. Different plant species are highly variable with respect to their optimum environments, and a harsh environmental condition, which is harmful for one plant species, might not be stressful for another (Larcher, 2003; Munns and Tester, 2008). This is also reflected in the multitude of different stress-response mechanisms.

Zeid (1992) & Hussein (1999) suggested that increasing sugar content can play a role in osmoregulation, which increase the capacity of roots to absorb water from the soil, while the polysaccharides as well as the total carbohydrate declined with the deficiency of water supply. (Kemble and MacPherson 1954), numerous studies have shown that the proline content in higher plants increases under different environmental stresses. The pigment contents could be regarded as a criterion for photosynthetic activities (Sestak, 1967 & Raafat et al., 1971). Batanouny et al. (1991) reported that there is a relationship between the photosynthetic pathway and the ecological conditions in the habitat of a particular species.

*Lyciumshawii* Roem. & Schult. Is a thorny perennial small tree or shrub that belongs to the Solanaceae family. It grows along sandy stone ridges. It has purple, sometimes white, trumpet – like flowers and sharp thorns. The leaves are elliptical and congested in closed clusters (Omar *et al.*, 2007). The flowers are produced during March to April in its natural environment and throughout the year in irrigated soil. The fruits are globular, many seeded, red to orange berries which are edible and somewhat sweet. It provides honey for wild bees and food and shelter for wild birds and animals (Sudhersan *et al.*, 2003). In Yemen, the pounded leaves of this shrub have been used as a cure for eye ailments. Livestock eat new growth on the plant. Habitats include gravel plains and foothills up to 4,000 feet as well wadis. Plant associates growing nearby often include *Acacia tortilis*.

## II. Materials and Methods

### 1.1 Study Area

Taba protected area is the fifth component of the South Sinai Protected Area Network. TPA is situated in the Southeast part of Sinai and is a part of the upper Sinai massif. It is located between 33° 55' to 34° 50' east, 28° 52' to 29° 36' North and Alt. 100 to 1150 m a.s.l. The study area (Map, 1) involves wadi systems. Taba has an extremely high recreational, conservational and scientific value, which is currently being compromised by human activities. It includes a wide variety of landscape features supporting a high diversity of habitat types and biological components.

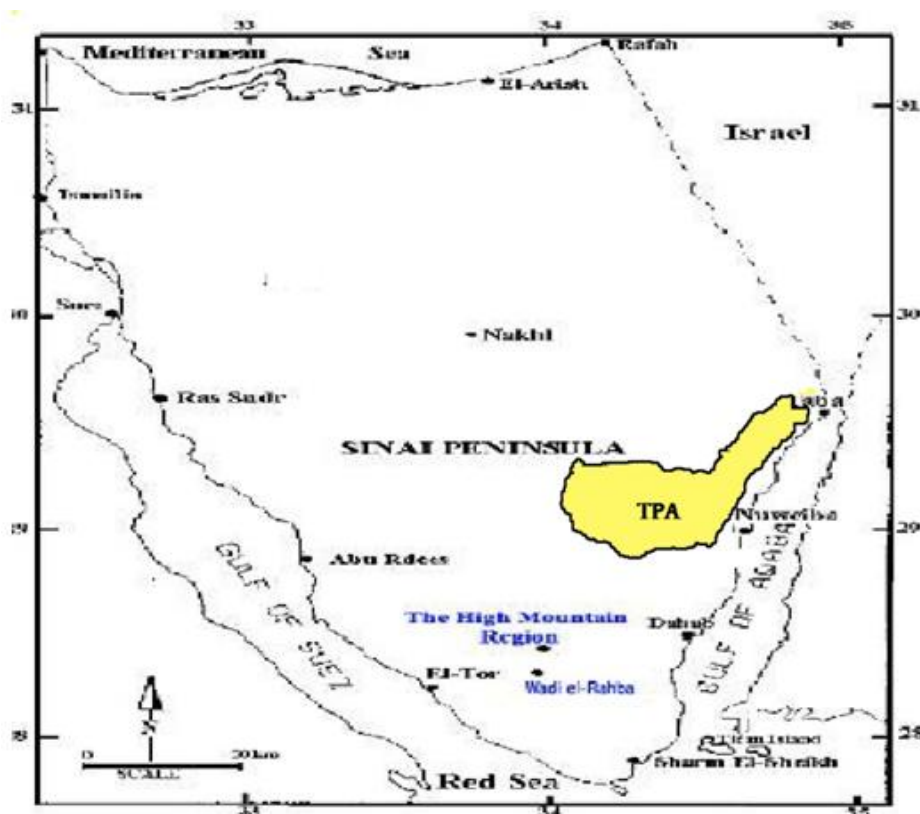


Figure 1: Sinai Peninsula map within the TPA area.

Four Wadis were selected for this study, especially altitude range and must represent the protectorate area. The first is Wadi EL Mora located between 850m to 1100m altitude. The second is Wadi El Zalaga located between 700m to 1050m altitude. The third is Wadi Ghazala which include two Part located between 300m to 650m altitude. And the fourth is Wadi Watier which located between 100m to 400m altitude (Map, 2). Cloudiness in the TPA is very low, has long summer (April Early November) and short winter (December to March). Summer temperature on land may reach 45 c. Rainfall in the studied area is about 22 mm per year, although exceptionally rainy years with as much as 70 mm rainfall may occur. Flash floods through major wadis (in winter) transport terrestrial material into the Gulf of Aqaba, resulting in large deltas and incision of submarine canyons. Annual evaporation rates on land are three times as high as along the Mediterranean shore. Relative humidity in shore localities averages 30-55%. Wind direction is predominantly from the north (approx. 50% frequency) and from the northeast) approx. 20% frequency). A minor northwestern component,

particularly in winter is present, while winds from the south are subordinate. Average wind speed is about 10-15 knots. Southerly winds in excess of 20 knots were observed mainly in winter.

### 1.2 Soil sampling and Methodology

Soil samples were collected during the work, from all the thirty-one stands for the determination of their physical and chemical characteristics. The surface samples (excluding the surface crust) were taken from the depth of 20 cm. Physical characteristics, Soil texture was determined by using a series of sieves: fine gravel (2 mm), coarse sand (500 $\mu$ m), fine sand (212 $\mu$ m), silt (106 $\mu$ m) and clay (53 $\mu$ m). These samples were then taken for the laboratory, weighed and dried to constant weights at 105°C. The difference between the fresh and oven dry weights of each sample was considered to represent the moisture content and was expressed as percentage of the oven dry weight (Jackson, 1967).

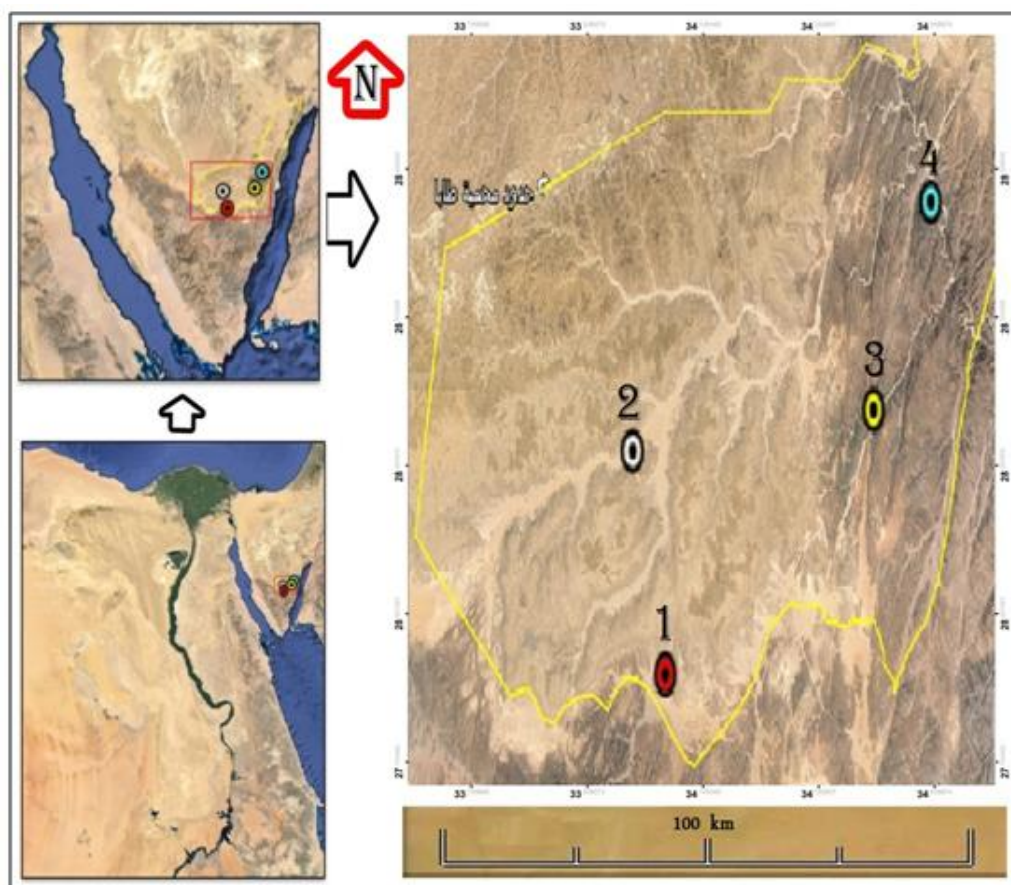
Chemical properties, Five hundred ml of distilled water was added to 100 g of air – dried soil (with a 2 mm sieve), and were shaken for two hours. The heavier particles were allowed to settle, and the supernatant liquid was decanted by filtration. After repeated filtrations, clear soil solution was obtained to analysis the pH, EC, T.D.S, Org. matter, CaCO<sub>3</sub>, Ca ++, Mg ++, HCO<sub>3</sub>, Cl and SO<sub>4</sub> (Jackson, 1967).

### 1.3 Plant sampling and Methodology

Four wadis which under study as shown in Map 2. The selection of tested samples was depending upon the following criteria:

- 1- The presence of target species within all locations.
- 2- The target species has importance environmental and economic high value.

At each site three species were collected to reflect the amount of metabolic contents. Samples (leaves) collected during one seasons at (April to May, 2014). The starting material for estimation of carbohydrates and nitrogenous constituents was the dried plants. The plant material was rapidly dried in an oven at 75°C to constant weight and then ground to a fine powder. These samples were taken for the physiological parameters testing (Water soluble protein, Soluble Carbohydrate's, Proline and Photosynthetic Pigments) according to (Lowery *et. al.*, 1951 and Bates *et. al.*, 1973).



**Figure 2:** Location map of study area, 1- W. El Mora, 2- W. El Zalaga, 3- W. Ghazala and 4- W. Watier.

### III. Results and Discussion

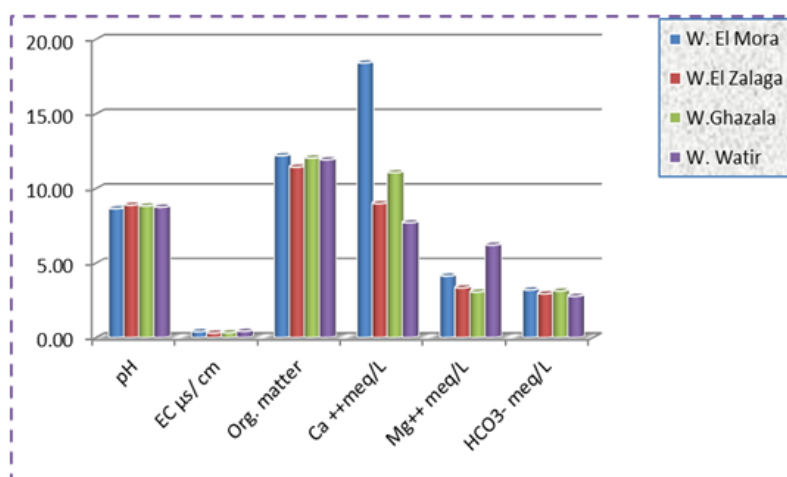
#### 1.1 Soil analysis

Physical characteristics, Variations among the four Wadis in the average of soil physical properties were recorded as follow: Results showed variation among the four Wadis which studies in average of soil texture, Wadi El Zalaga and Wadi Gazala are sandy loam, and Wadi El Mora is Lomy sand, While Wadi Watier is Lomy soil texture. Moisture content showed variation among the 4 Wadis, Wadi El Mora and W. Watier present the highest value (1.44%) and W. El Zalaga present the lowest one (1.21%). While Wadi Ghazala presents 1.27 %.( Fellow Table -1).

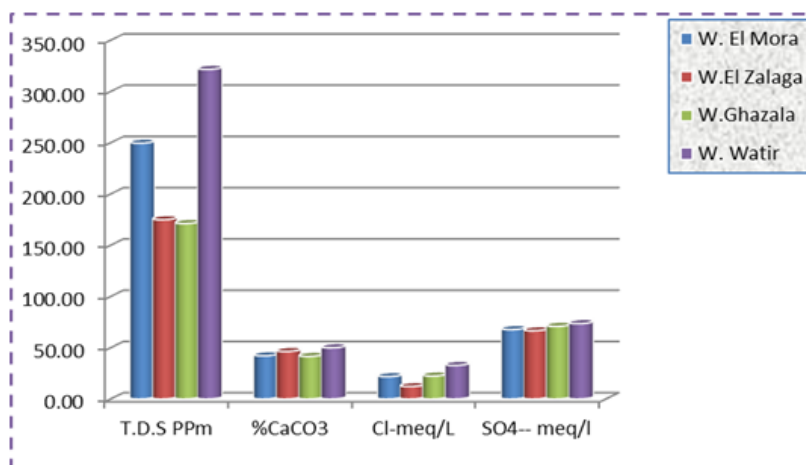
**Table 1.** Physical properties of soil samples collected within the study area

L.no	L.name	Water Content	Fine gravel	Sand	Silt	Clay	%Sand	%Silt	%Clay	Texture
1	Wadi El Mora (±922 6m a.s.l.)	1.44	5.84	79.20	11.16	3.80	84.11	11.79	4.10	Lomy Sand
2	Wadi El Zalaga (±881 m a.s.l.)	1.21	0.28	66.87	22.39	10.46	67.05	22.46	10.49	Sandy Lomy
3	Wadi Ghazala (±491 m a.s.l.)	1.27	6.43	72.60	14.95	6.01	77.78	15.75	6.46	sandy loam
4	Wadi Watir (±262 m a.s.l.)	1.44	2.96	53.32	24.33	19.40	55.25	25.00	19.75	Lomy

Chemical properties of soil showed great variation among the different location according to elevation ranks. Results found that soil pH (8.66, 8.89, 8.84 and 8.76), HCO<sub>3</sub> values (3.21, 2.95, 3.14 and 2.79), and organic matter values (12.21, 11.45, 12.06 and 11.94) increased with elevation while CaCo<sub>3</sub>, CL, SO<sub>4</sub> and EC decreased with elevation without Location Wadi El Mora (Fig 3).



**Figure --.** Chemical properties of average soil among different locations.



**Figure 3:** Chemical properties of average soil among different locations.

### 1.2 Plant chemical analysis

Results derived from the chemical analysis of plant species were managed and illustrated separately within and among locations (Wadi El Mora, Wadi EL Zalaga, Wadi Ghazala and Wadi Watier). At each site one sample of plant species (*Lycium shawii* Roem. & Schult) was collected to reflect the amount of metabolic contents. From statistical analysis, we found that there are highly significant differences between plant chemical contents, Protein, Carbohydrate's, Proline and Chlorophyll A content but Total Chlorophyll B (F = 9.329, P = NS),(Table 2).

**Table 2.** Results derived from one-way analysis of variance (ANOVA) of some physiological parameters for *L. shawii* species among different locations. Each value is mean for 3 replicates ± standard error of means. It means in not significantly different according to LSD. \*\*\* = significant at P < 0.001 and NS = non-significant at p > 0.001

Location Names	W.El Mora	W.EL Zalaga	W.Ghazala	W.Watier	F	Sig.
	±922 6m a.s.l.	±881 m a.s.l.	±491 m a.s.l.	±262 m a.s.l.		
Total soluble protein	22.15±0.06	23.14±0.02	27.64±0.22	23.42±0.03	399.943	***
Soluble Carbohydrate's	2.93±0.03	4.11±0.06	1.89±0.04	3.31±0.06	345.871	***
Total Proline content	2.93±0.02	1.64±0.01	1.72±0.00	2.88±0.08	288.053	***
Total Chlorophyll A	1.46±0.03	2.99±0.05	1.21±0.01	2.45±0.16	92.509	***
Total Chlorophyll B	0.31±0.02	0.39±0.08	0.04±0.00	0.26±0.05	9.329	NS
Total Chlorophyll A+B	1.77±0.02	3.38±0.13	1.25±0.01	1.25±0.01	219.545	***

Chemical analysis were shown that, total soluble Carbohydrates, and all pigment's contents (Chl a & Chl b) represent the highest value in Wadi El Zalaga during Species growth. And on the other hand, W. El Zalaga recorded less value in Proline contents. From these results, it is clear to us that the W. El Zalaga is the best distribution site for *Lycium shawii*. Because W. El Zalaga is the suitable site for highest metabolic production.

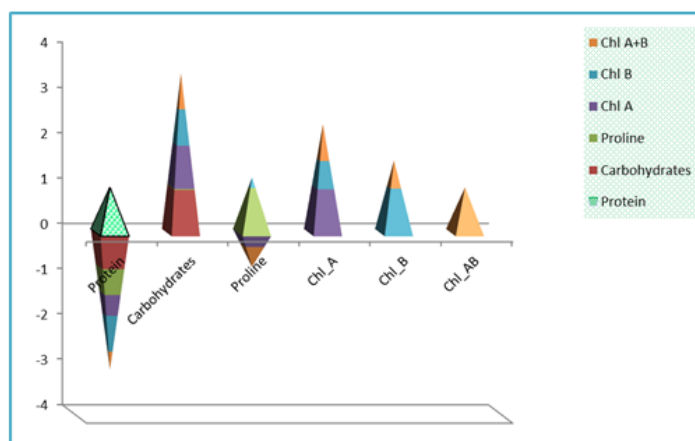
### Correlations detection between different metabolic contents for *L. shawii*:

From Table 3 and Figure 4, we extract that during species growth; total soluble carbohydrate showed positively correlated with all Pigments contents. But; total soluble protein negatively correlated with all metabolic contents (total soluble carbohydrate, proline, chlorophyll a and chlorophyll b). It's shown that there are great variations in metabolic correlation that may reach to be in the reverse way, and this may be results from the variation in locations and environmental factors.

**Table 3.** Bivariate Pearson correlations between water soluble proteins, the total soluble carbohydrate, proline and pigment parameters for *L. shawii*.

	Protein	Carbohydrates	Proline	Chl_A	Chl_B	Chl_AB
Protein	1					
Carbohydrates	-.745 <sup>**</sup>	1				
Proline	-.585 <sup>*</sup>	.021	1			
Chl_A	-.472	.932 <sup>**</sup>	-.264	1		
Chl_B	-.809 <sup>**</sup>	.784 <sup>**</sup>	.218	.606 <sup>*</sup>	1	
Chl_A+B	-.407	.776 <sup>**</sup>	-.486	.787 <sup>**</sup>	.594 <sup>*</sup>	1

\*\* . Correlation is significant at the 0.01 level (2-tailed).  
\*Correlation is significant at the 0.05 level (2-tailed).



**Figure 4.** Correlation relationship between different metabolites for *L. shawii*.

#### IV. Conclusion

Regarding to the previous results, we can summarize the major conclusions for this study as; it was found that heterogeneity at ecological variables (special edaphic factor) lead to change in biochemical contents to plants. We found that environment inadequate conditions promoted by abiotic factors such as water, salt, and mineral elements can provoke reductions in growth and development in plants, disorders physiological and biochemical contents. The variation on soil characters plays a great role in the variation of the biochemical contents. Statistical analysis of the obtained results showed variation in total carbohydrate contents among different wadies and this may come from variation in water stress which may be due to the decrease in photosynthetic process beside an increase of respiration in different plant species. We record close relationship between the growth stage and the different habitats as regards the contents of chlorophyll a, chlorophyll b as well as chlorophyll a+b contents. In this regard according to (Batanouny et al., 1991) reported that there is a relationship between the photosynthetic pathway and the ecological conditions in the habitat of a particular species. This variation on physiological parameters can be used ineconomic issue, that we can help local communities to detect the time and place where they can collect their plants for commercial use or for grazing. It is very urgent to use this study in the coming planning process within the Taba PA to reduce the negative impact of overgrazing by allowing to local community grazing in some wadis and the closure of others in different years. So, we recommended using this study as a model for know how the condition of vital ecosystem.

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