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VARIABILITY AMONG THYMELAEA HIRSUTA (L.) ENDL. POPULATIONS IN EGYPT

BY

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ABSTRACT

The present study depicts the presence of a gradient in the morphological characters of Thymelaea hirsuta (L.) Endl. leaves which correlated with the environmental gradients prevailing in the Western Mediterranean region of Egypt. The less arid and more calcareous habitats harbour individuals with obtuse and gentle curved leaf apices and gentle involute leaf margins. With the increase of aridity and decrease of $CaCO_3$, the leaf apices become acute and strong curved, and the leaf margins become strong involuted. Significant variations in seed weight, seedling emergence and viability of seed embryos in T. hirsuta, in relation to habitat types, are also showed and discussed.

INTRODUCTION

Thymelaea hirsuta (L.) Endl. is a perennial ever-green circum-Mediterranean shrub. It is described by Freitag [1] as a shrub of dry and hot places , steppes, semi-deserts and deserts, particularly in North Africa, resistant to dust in the air and salt in the soil and also to extremely dry atmospheric and soil conditions. In Egypt, it is one of the commonest species along the Mediterranean coast of Egypt forming an alliance, Thymelion hirsutae, which extends southwards to approximately 70 Km from the coast [2-5[. This distribution is associated with Wide environmental gradients from the coast to the inland desert. The most obvious gradients are increase in aridity and change from calcareous to siliceous deposits.

The present study assesses the impact of prevailing environmental gradients on two sets of characteristics: leaf morphology as a markor of phenotypic variation and of adaptation to low levels of mineral nutrients, and, seed and seedling traits linked with the survival component of fitness, during establishment.

The sample collection sites (17 sites) were distributed along a transect extending from the Mediterranean coast at Omayed (80 Km West of Alexandria) to about 40 Km southward. The landscape of this area is distinguished into a northern coastal plain, and a southern plateau. The coastal plain supports four major habitats arranged, from north to south, in the following sequence: coastal ridge, saline depression, non-saline depression and inland ridge. The southern plateau supports two habitats: inland plateau proper, and inland siliceous deposits which is the farthest from the coast [5,6].

MATERIALS AND METHODS

Samples were collected randomly from at least two T. hirsuta shrubs in each of the 17 sites that represents six habitat types previously mentioned. At least 2 branches from each shrub, and a sample of seeds from each female shrub were collected. The branches were pressed and prepared as herbarium specimens. The total specimens were 137 represent 49 T.hirsuta adult individuals. In each specimen seven morphological leaf characters were described or measured for ten randomly selected leaves. The total character states are 33:23 represent the states of qualitative characters, and 10 represent the states of the quantitative ones (cf. annexe). Sometimes, the leaves of the same branch had different character states with regard to the same qualitative character. For example, the greater number of leaves on the same branch may have an ovate shape of blade, while the rest have a triangular shape, then this state was named ovate-triangular (mixed state). So, in case of the mixed states, the written first was the more dominant on the branch. For the quantitative characters, length and width averages were calculated for each branch and discretized in 5 classes. After that, the data matrix (137 samples x 33 characters states) based on the presence-absence records was used to ordinate the samples according to the factorial analysis of correspondences [7].

Seeds collected from each female shrub were counted and weighted, and the average seed weight in mg was calculated. The viability of seed embryos was tested by the tetrazolium method [8]. For germination experiment, seeds were treated with 95% H_2SO_4 for 10 minutes and soaked in 500 ppm aqueous solution of GA_3 for 24 hours [9]. Ten pretreated seeds from each shrub were sown in potted sterilized loamy sandy soil (1 seed/pot) in a greenhouse adjusted to be near the germination and survival requirements of this plant. The emerged seedlings were counted every day for a period of 30 days. The survived seedlings were recorded weekly for a period of 22 weeks

RESULTS

The distribution of points representing *T. hirsuta* branches on the first two axes of the factorial analysis of correspondences (drawn points are only those with considerable contribution to, at least, one of the ordination axes) has an inverse V-shaped pattern. To compare this ordination with habitat types, the samples belonged to each habitat types were encircled (Fig. 1). It is clear that, almost the group representing the habitats of coastal plain (coastal ridge, saline depression and non-saline depression) are located on the left, and those of the southern plateau (inland plateau and siliceous deposits) are located on the right. On the other hand, the samples of inland ridge (belonging to the habitat of coastal plain) are splitted into two groups: one allocated with the habitats of coastal plain, and the other with the habitats of southern plateau. As indicated in Fig.2, there is an obvious gradient in almost all of the qualitative leaf characters associated with the inverse V-shaped pattern of the samples ordination.

The variation in the leaf dimension in relation to habitat types indicates that the leaves of saline depression are significantly longer (3.03 mm/leaf) than those of other habitats (Table 1). The seeds of saline depression are also significantly heavier (4.3 mg/seed) than those of other habitats (Table 2). On the other hand, the seeds collected from coastal ridge are the lightest and had the lowest percentage of viable embryos (20%).

With regard to seed germination (Fig. 3), the seeds of non-saline depressions are characterized by significant higher seedling emergence percentage (41%) and those of coastal ridge attain the lowest percentage (16%). Although no statistically significant variation was detected for the variation in the survival of T. hirsuta seedlings in relation to habitat types (Fig. 4), we should mention that seedlings emerged from the saline depression seeds had the highest survival percentage (75%). With respect to the net gain of seedlings attained after 22 weeks out of 100 seeds (Fig. 5), it is shown that the seeds of non-saline depression attained the highest gain (28 seedlings/100 seeds).

DISCUSSION

The application of the multivariate techniques on the variation of the leaf morphology of some desert plants seems to be efficient for depicting the nature of correlation between the gradient of the morphological characters of their leaves and the gradient of the prevailing environmental factors (e.g. Lausi and Nimis, 1986). The application of the factorial analysis of correspondances on the data of morphological characters of T. hirsuta leaves, in the present study, showed an inverse V-shaped pattern of the investigated samples. Such pattern may indicate a gradient pattern of the data [11]. This could be observed from distinguishing the samples in two parts: one represents the individuals grown in the less arid and more calcareous habitats (almost the habitats of coastal plain); and the second represents those grown in the more arid and less calcareous habitats (habitats of southern plateau). The bimodal behaviour of the individuals grown in inland ridge, in relation to the environmental gradients prevailing in the area of the present study, may be interpreted in the view of considering this habitat as a transitional area between the coastal plain and southern plateau [12].

Concerning the mode variation in the morphological characters of T. hirsuta leaves, the present study reveals that the less arid and more calcareous habitats harbour individuals with obtuse and gentle curved leaf apices and gentle involute leaf margins. With the increase of aridity and decrease of $CaCO_3$ towards the southern plateau, the leaf apices become acute and strong curved, and the leaf margins become strong involuted. Such type of modification under aridity stress may be considered to aid water conservation [13]. As quoted by Kramer [14], the rolling of leaves reduces transpiration about 35% for plants of moist habitats, 55% for the mediterranean species, and 75% in some desert xerophytes.

The measurement of the leaf dimensions of *T. hirsuta* indicates that this plant is a sclerophyllous plant and its leaf lies in the leptophyll class of Raunkier [15] with surface area less than 25 mm^2. As reviewed by Specht [16], sclerophylly may be an evolutionary character produced in response to the low level of mineral nutrients, especially phosphorus. In certain species, the normal development of the sclerophyllous leaf from the mesophytic juvenile leaf on young shoots may be delayed considerably by the application of phosphate fertilizer [16 - 20]. In the view of this, one can interprete why the habitat of saline depressions, which is characterized by significantly higher content of phosphorus compared to other habitats in the area of the present study [5], harbour *T hirsuta* shrubs with leaves significantly larger than those of other habitats.

With respect to the variation in the seed characteristics of T. hirsuta in relation to habitat types, the present study depicts significant variation in the seed weight, viability of seed embryo, and seed germination. Such variation exhibited in seeds obtained from the mature plants was presumed, by some authors, to be genetically rather than environmentaly induced [21 , 22]. It is of interest to compare between the seed size and the other seed characteristics. In the present study, the population of T. hirsuta which attained the lighest seeds was also characterized by the lowest percentage of viable seed embryos and seed germination (coastal ridge). Some studies are in agreement with the present finding [23], and others reported an opposite relationship between seed size and seed germination [24]. On the other hand, the population of heaviest seeds was characterized by the highest survival percentage of seedlings (saline depression). As reported by Harper [25], the seed size is considered as one of the seed characteristics that may dictate some safe sites. Thus it has been supposed that the larger seeds possess more stored energy to survive than the smaller ones.

Under the natural conditions, T. hirsuta population growing in non-saline depression, in the area of the present study, is considerably more dense, particularly with seedlings and young individuals than those of other habitats [5]. The present study indicates also that, the seeds collected from this habitat attained, under uniform experimental conditions, the highest number of survived seedlings. Thus one may report that the abundance of T.hirsuta individuals in the habitat of non-saline depressions as compared to other habitats may be due to more favourable environmental conditions and/or due to some degree of ecotypic variation between its seed characteristics and the seed characteristics of other habitats. As the term ecotype is now used by botanists and ecologists to indicate any degree of genetic differences below the level of the species which is habitat correlated [26], future studies on offsprings originated from T. hirsuta seeds, collected from individuals grown under uniform conditions, must be carried out in order to assess wether or not exhibits ecotypic variability among the individuals of the populations of T. hirsuta in Egypt.

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ANNEXE

CHARACTER ATATES:

Shape of the blade: 1-Ovate, 2-Ovate-triangular, 3-Triangular-ovate, 4-Triangular.

Top view of the apex: 5-Obtuse, 6-Obtuse-acute, 7-Acute-

obtuse, 8-Acute
Side view of the apex: 9-Gentle curved, 10-Gentle-strong curved, 11-Strong-gentle curved, 12-Strong curved
Involution of the margin: 13-Gentle involuted, 14-Gentle-strong involuted, 15-strong-gentle involuted, 16-Strong involuted
Appearing of the mid rib: 17-Disappeared, 18-Disappeared-incomplete, 19-Disappeared-incomplete-complete, 20-Incomplete, 21-Incomplete-complete,22-complete-incomplete, 23-Complete
Length: 24 to 28 (five classes)
Width: 29 to 33 (five classes)

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Figures

Figure 1:

Factorial analysis of correspondences applied to the matrix of 33 morphological characters states x 137 sampled branches of _T. hirsuta_ representing six major habitat type (only samples with high contributions are represented)

Figure 2:

Modes of variation in the states of some morphological characters on factorial analysis of correspondences

Figure 3:

Percentage of seedling emergence

Figure 4:

Percentage of seedling survival

Figure 5:

The net gain of survived seedlings (after 22 weeks) out of 100 seeds

Tables

Table 1:

Results of one-way analysis of variance of leaf dimensions of _T. hirsuta_ shrub in sites representing six habitat types. Means with common letters are significantly different at 0.05 probability level according to LSD test

Table 2:

Results of one-way analysis of variance of seed weight and viability of seed embryos of _T. hirsuta_ shrub in sites representing six habitat types. Means with common letters are significantly different at 0.05 probability level according to LSD test

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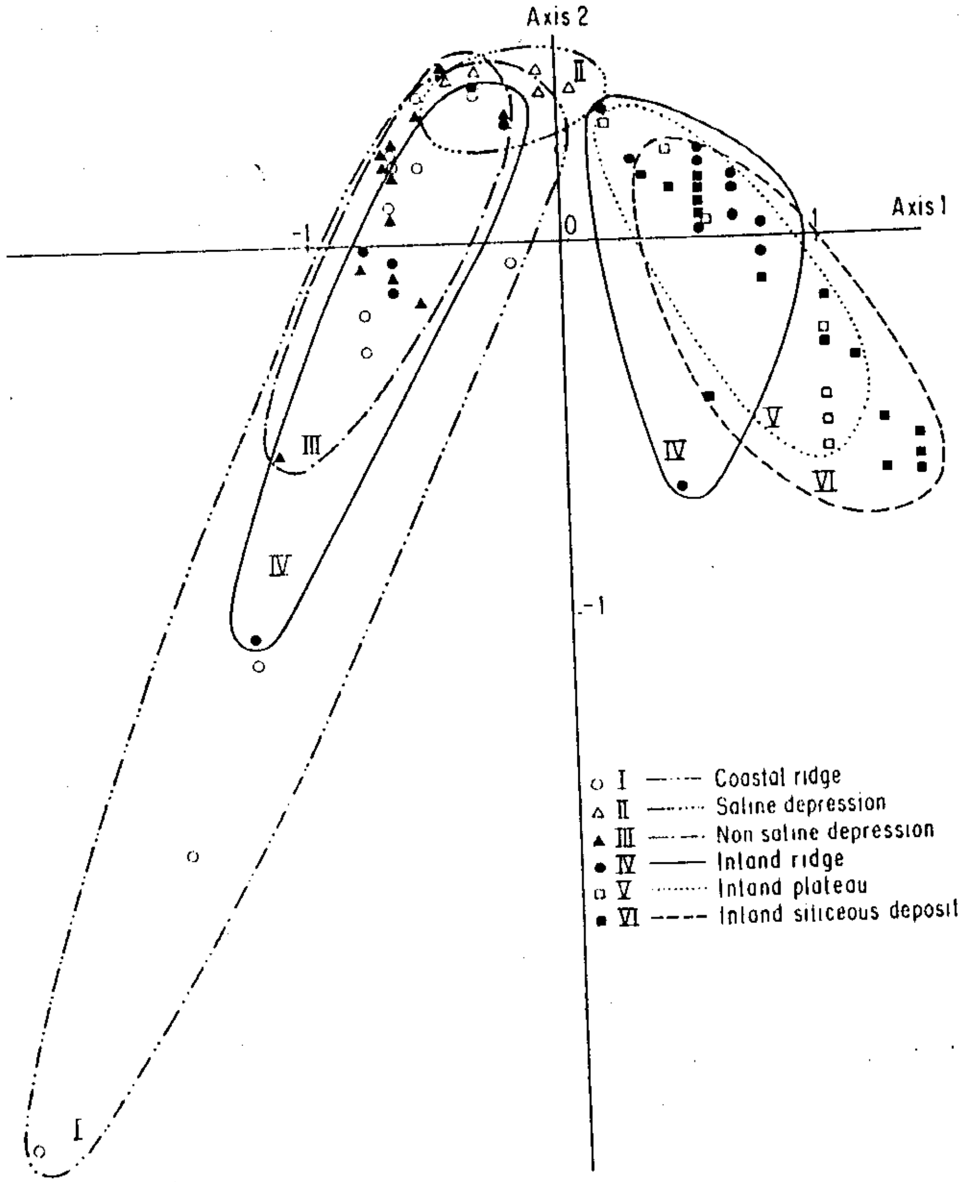

Fig. 1

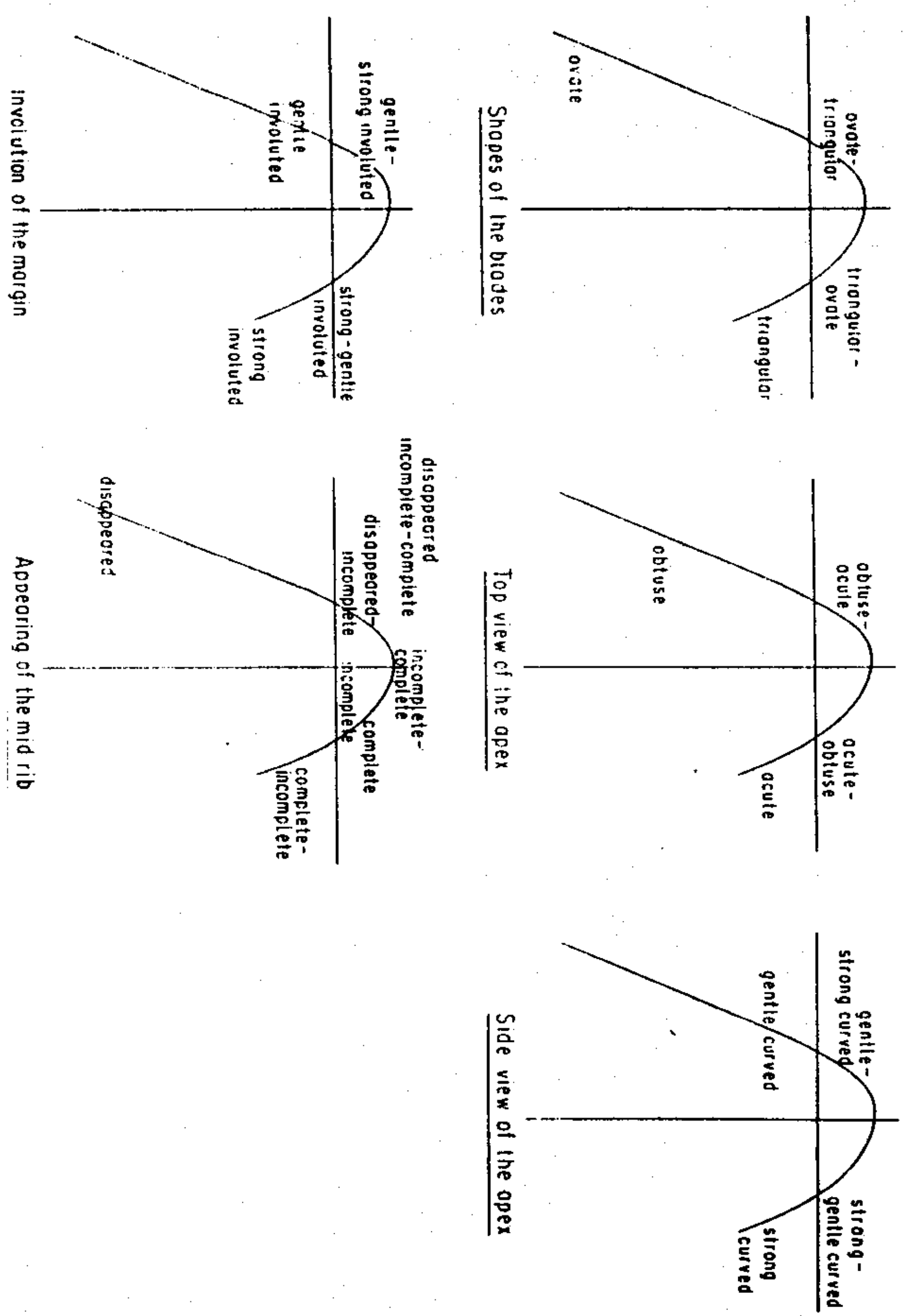
ovate
ovate-
triangular
triangular-
ovate
triangular
Shapes of the blades
obtuse
obtuse-
acute
acute-
obtuse
acute
Top view of the apex
gentle-
strong curved
gentle curved
strong-
gentle curved
strong
curved
Side view of the apex
gentle-
strong involuted
gentle
involuted
strong-gentle
involuted
strong
involuted
Involution of the margin
disappeared
incomplete-complete
disappeared-
incomplete
incomplete-
complete
incomplete
complete
complete-
incomplete
disappeared
Appearing of the mid rib

Fig.2

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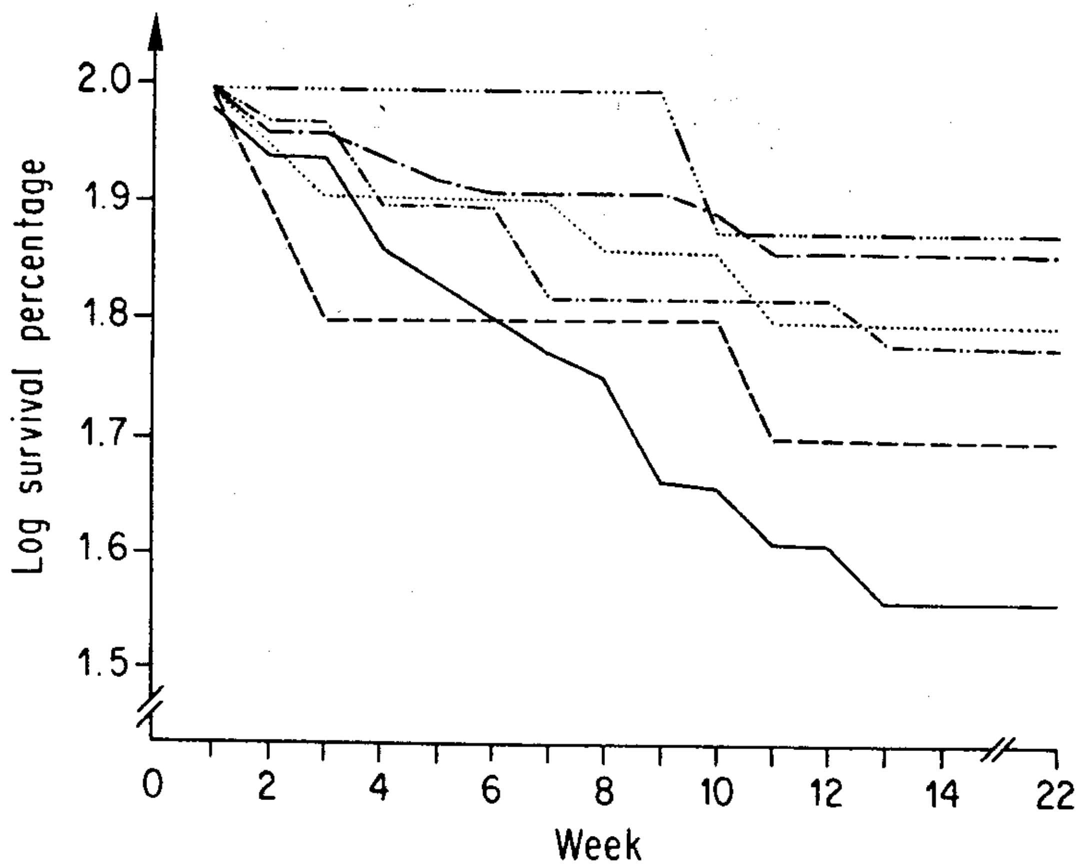

Fig. 3

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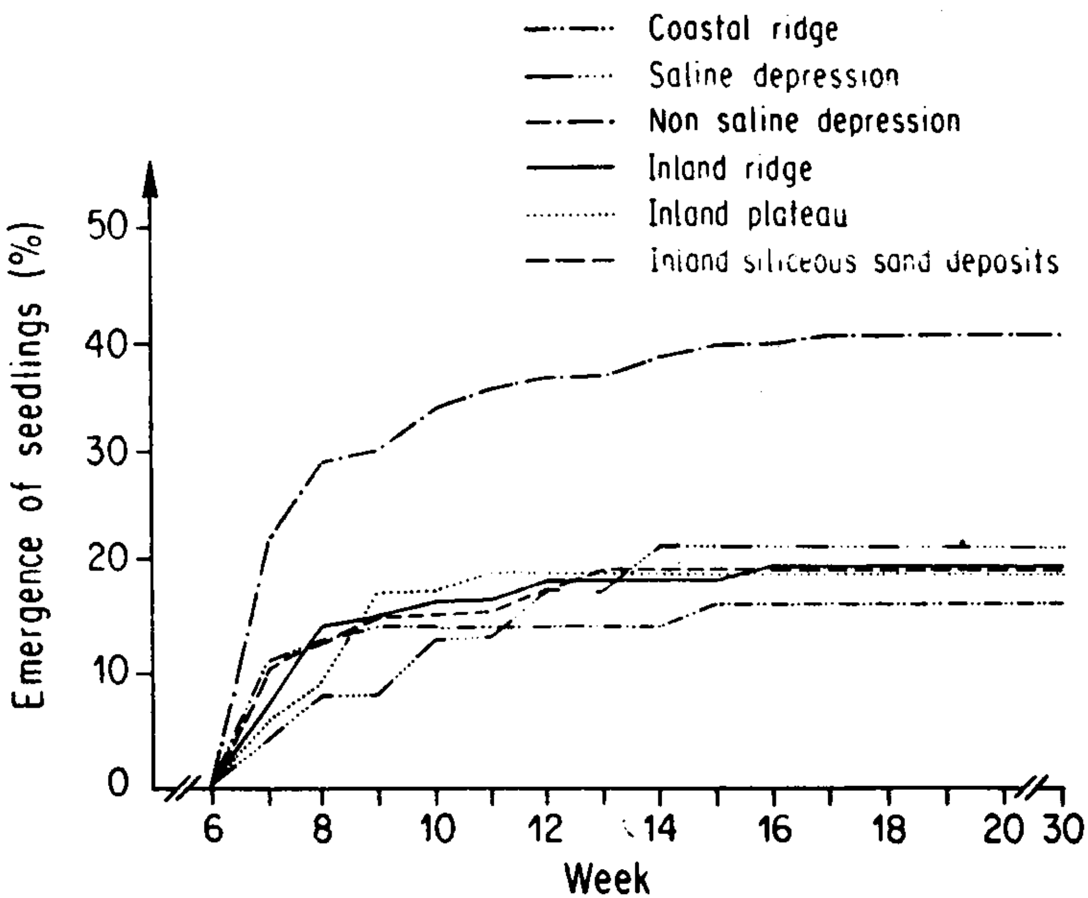

Fig. 4

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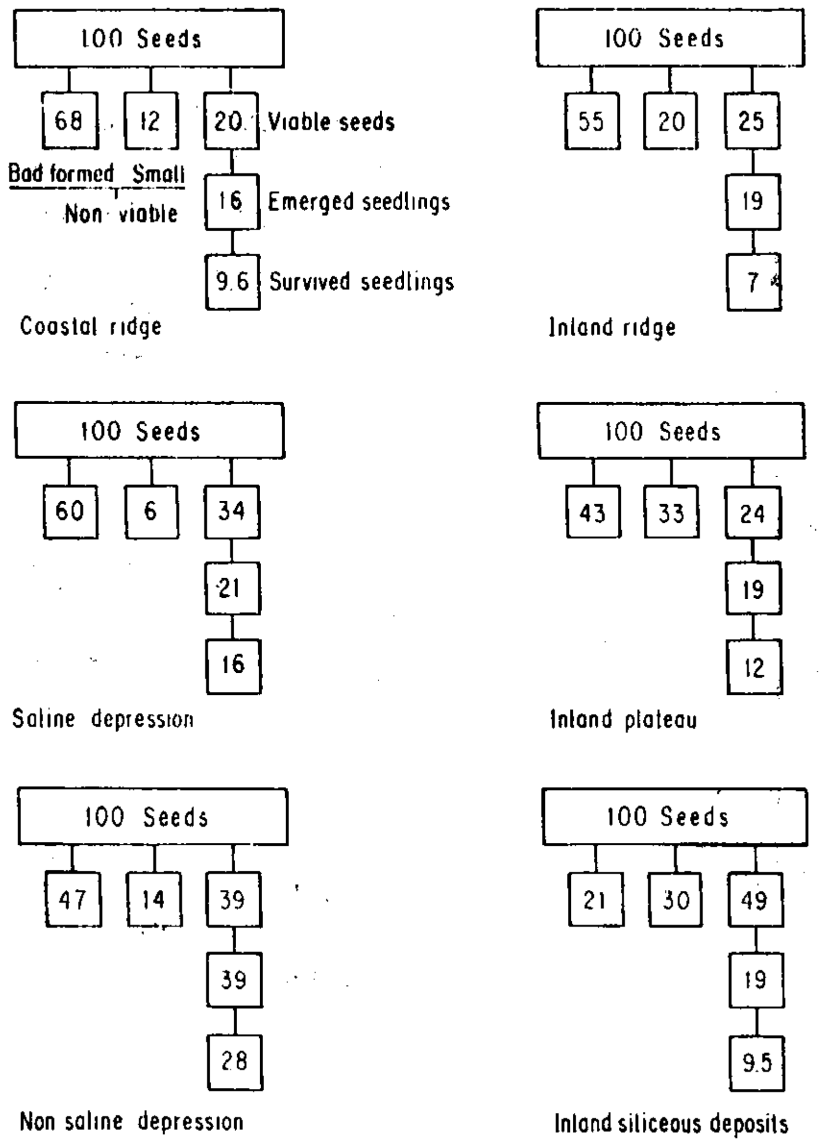

Fig. 5...

Table 1

Leaf Dimension (mm)	Habitat Type							
	Coastal Ridge	Saline Depression	Non Saline Depression	Inland Ridge	Inland Plateau	Inland Siliceous Deposits	F	P
Length	a 2.68	abcde 3.03	bf 2.78	cdfg 2.54	d 2.75	eg 2.81	6.52	<0.005
Width	1.65	1.77	1.79	1.73	1.72	1.75	1.73	>0.05
Length / Width	a 1.63	b 1.71	b 1.56	abc 1.47	c 1.65	b 1.61	7.86	<0.005

Table 2

Seed Character	Habitat Type							
	Coastal Ridge	Saline Depression	Non Saline Depression	Inland Ridge	Inland Plateau	Inland Siliceous Deposits	F	P
Seed Weight (mg/seed)	a 2.8	abcde 4.3	b 3.4	c 3.3	d 3.4	e 3.3	3.98	0.005–0.01
Bad Formed Non Viable Embryos (%)	ab 68.0	ab 60.0	a 47.0	ab 55.0	b 43.0	ab 21.0	6.53	<0.005
Small Non Viable Embryos (%)	ab 12.0	ab 6.0	ab 14.0	ab 20.0	a 33.0	b 30.0	5.38	<0.005
Total Non Viable Embryos (%)	ab 80.0	ace 66.0	bce 61.0	c 75.0	e 76.0	abce 51.0	3.93	0.005–0.01
Viable Embryos (%)	ab 20.0	ab 34.0	ab 39.0	a 25.0	b 24.0	ab 49.0	3.11	0.010–0.05

التباين بين تجمعات نبات المثنان فى مصر

كمال حسين شلتوت ، نيكول نيتل ، بيير جاكارد و فرانسوا رومان
قسم النبات ـ كلية العلوم ـ جامعة طنطا ـ طنطا ـ ج٠م٠ع٠
مركز لويس أمبير جير ـ مونبلييه ـ فرنسا

أوضحت هذه الدراسة وجود تدرج فى الخصائص المورفولوجية لنبات المثنان مصاحب للتدرج المناخى السائد فى أماكن تواجده بالساحل الشمالى الغربى لمصر٠

فقد لوحظ أن قمم أوراق هذا النبات التى تعيش فى البيئات الأقل جفافيه وذات المحتوى العالى من كربونات الكالسيوم مستويه وخفيفه الانحناء وان حافتها قليلة الانثناء ومع زيادة الجفافية ونقص محتوى التربة من كربونات الكالسيوم تصبح قمم الاوراق مدببه وشديدة الانحناء وحافتها شديدة الانثناء٠ أظهرت الدراسة أيضا وجود تباينات معنوية فى وزن البذره وحيوية أجنتها ونسبة ظهور البادرات بين تجمعات هذا النبات فى البيئات المختلفة٠