BIOMETRIC OBSERVATIONS ON *IPOMOEA PURPUREA* (L.) ROTH (CONVOLVULACEAE) LEAVES

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ABSTRACT

The paper discloses a research model of leaf investigation, based on biometrical measurements and morphological observations. There are only a few examples of this type of biometrical investigation and analysis model applied on spontaneous plants leaves in literature. The article comprises biometrical investigations on *Ipomoea purpurea* (L.) Roth leaves. The measurements and observations were performed on 40 mature leaves of the studied genotype, including linear measurements, percentage ratio, angular measurements and the leaf surface as well. The biometric measurements were the basis of a mathematical calculation of the average values on the studied species.

INTRODUCTION

*Ipomaea*L. is a genus with over 400 climber or prostrate species.*Ipomoea purpurea* (L.)Roth(syn. Pharbitispurpurea (L.) Voigt), popularly known as the morning glory, is an annual climbing herb of *Ipomoea* genus,belonging to Convolvulaceae family and is originating in Mexico and Central America.Like all morning glories *Ipomoea*, it wraps around supports and can grow up to 2-3 m. The plant is well branched from the base and stems are covered with brown hairs. It has large green ovate-cordate-shaped and glabrous or pubescent leaves. The blue, red and violet flower corolla is funnel-shaped and has 2-4 cm in diameter. The fruits are capsules(Henderson, 2001; Everitt et al., 2007).

Meny sets of terms and methods have been devised for describing leaves (e.g. Hably and Zastawniak, 2001; Dale *et al.* 1971; Dickinson *et al.*, 1987; Hickey 1973; Jensen, 1990; Melville, 1976; Ray, 1992; Roth andDilcher, 1978). The methods and terms for the leaves description form and venation are largely from the leaf architectural system of Mounton (1966a,b, 1967, 1976).

In Romanian literature there are few examples of this type of leaf investigation and analysis model applied on spontaneous plants leaves (Bercu, 2005), mostly of them being paleontological studies (Givulescu, 1999, GivulescuandSoltesz, 2000). Some data refers to general biometric features such as lamina venation, mentioned in lectures and manuals of Botany, Anatomy and morphology of plants or Morphology of plants (e.g. Andrei, 1997; Buia andPéterfi, 1965).

The purpose of this paper is to highlight the features of the leaf of *Ipomoea purpurea***and to contribute with**more information**to complete the morphological knowledge concerning this species.**

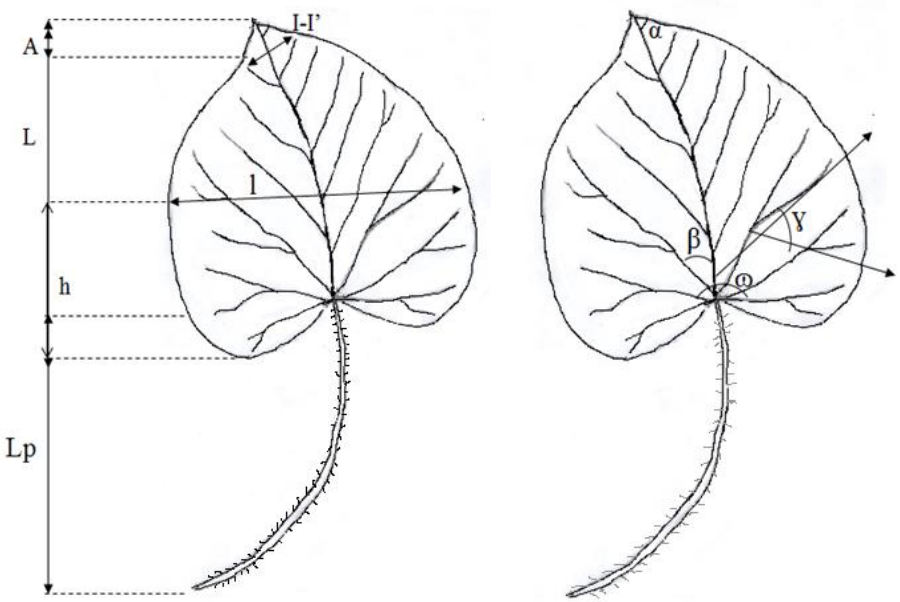
MATERIAL AND METHODS

The morphological observations and morphometric measurements were performed on 40 mature leaves of *Ipomoea purpurea*, collected from North Mamaia resort, Conatanrzain August 2015. The biometrical measurements which had been calculated are: the linear measurements: L- leaf length, l- leaf width, h- the height of the maximum width of lamina; A- the tip length, l-l'- the tip width; Lp- the petiole length, followed by the percentage ratio: L/l- the length-width ratio (the leaf finesse); A/L- the acuminate ratio, h/L- the ovality ratio; A/l-l'- the tip finesse. The angular measurements: α- the apical angle, β-

the emergent angle of the secondary veins with primaries, ɣ- the emergent angle of the tertiary veins related to the primary one,ω- the emergent angle of the primary veins and finally other measurements: the number semi-sum of secondary veins pairs (Np) and the lamina surface (S).For each leafwere carried out 15 measurements amounting to 640 performed on all the leaves.

RESULTS AND DISCUSSION

*I. Biometric observations.*The biometrical measurements performed on *Ipomoea purpurea*40 leaves (Tables 1, 2, Fig. 1), represented the base for an original mathematical calculation for the average values of measurements (Tables 3, 4).



a **b**

Fig. 1. Diagramshowing the linear (a) and angular (b) measurements on *Ipomoea purpurea* leaf.

Liniarmeasuremens (Fig. 1)

$$\overline{L}_{lp} = \sum_{i=1}^{n} \frac{L_{lp}}{n} = \frac{L_1 + L_2 ..... + L_n}{n} = \frac{67 + ... + 87}{40} = 75.12mm$$

$$\overline{l}_{lp} = \sum_{i=1}^{n} \frac{l_{lp}}{n} = \frac{l_1 + l_2 ..... + l_n}{n} = \frac{94 + ... + 98}{40} = 85.15mm$$

$$\overline{h}_{lp} = \sum_{i=1}^{n} \frac{h_{lp}}{n} = \frac{h_1 + h_2 ..... + h_n}{n} = \frac{23 + ... + 24}{40} = 20.97mm$$

$$\overline{A}_{lp} = \sum_{i=1}^{n} \frac{A_{lp}}{n} = \frac{A_1 + A_2 ..... + A_n}{n} = \frac{9 + ... + 5}{40} = 7.72mm$$

$$\overline{I-I'}_{Ip}=\sum_{i=1}^{n}\frac{I-I'_{Ip}}{n}=\frac{(I-I')_1+(I-I')_2+.....+(I-I')_n}{n}=\frac{25+.....+12}{40}=14.22mm$$

$$\overline{Lp}_{Ip}=\sum_{i=1}^{n}\frac{Lp_{Ip}}{n}=\frac{Lp_1+Lp_2+.....+Lp_n}{n}=\frac{70+.....+118}{40}=84,40mm$$

Percentage ratio

$$\overline{\frac{L}{l}}_{Ip}=\sum_{i=1}^{n}\frac{\left(\frac{L}{l}\right)_{Ip}}{n}=\frac{\left(\frac{L}{l}\right)_1+\left(\frac{L}{l}\right)_2+.....+\left(\frac{L}{l}\right)_n}{n}=\frac{0.71+.....+0.88}{40}=0.60\%$$

$$\overline{\frac{A}{L}}_{Ip}=\sum_{i=1}^{n}\frac{\left(\frac{A}{L}\right)_{Ip}}{n}=\frac{\left(\frac{A}{L}\right)_1+\left(\frac{A}{L}\right)_2+.....+\left(\frac{A}{L}\right)_n}{n}=\frac{0.13+.....+0.05}{40}=0.09\%$$

$$\overline{\frac{h}{L}}_{Ip}=\sum_{i=1}^{n}\frac{\left(\frac{h}{L}\right)_{Ip}}{n}=\frac{\left(\frac{h}{L}\right)_1+\left(\frac{h}{L}\right)_2+.....+\left(\frac{h}{L}\right)_n}{n}=\frac{0.34+.....+0.62}{40}=0.27\%$$

$$\overline{\frac{A}{I-I'}}_{Ip}=\sum_{i=1}^{n}\frac{\left(\frac{A}{I-I'}\right)_{Ip}}{n}=\frac{\left(\frac{A}{I-I'}\right)_1+\left(\frac{A}{I-I'}\right)_2+.....+\left(\frac{A}{I-I'}\right)_n}{n}=\frac{0.36+.....+0.55}{40}=0.50\%$$

Angular measurements (Fig. 1)

$$\overline{\alpha}_{Ip}=\sum_{i=1}^{n}\frac{\alpha_{Ip}}{n}=\frac{\alpha_1+\alpha_2+.....+\alpha_n}{n}=\frac{120+.....+95}{40}=82.75^o$$

$$\overline{\beta}_{Ip}=\sum_{i=1}^{n}\frac{\beta_{Ip}}{n}=\frac{\beta_1+\beta_2+.....+\beta_n}{n}=\frac{70+.....+35}{40}=38.87^o$$

$$\overline{\gamma}_{Ip}=\sum_{i=1}^{n}\frac{\gamma_{Ip}}{n}=\frac{\gamma_1+\gamma_2+.....+\gamma_n}{n}=\frac{45+.....+20}{40}=32^o$$

$$\overline{\omega}_{Ip}=\sum_{i=1}^{n}\frac{\omega_{Ip}}{n}=\frac{\omega_1+\omega_2+.....+\omega_n}{n}=\frac{165+.....+100}{40}=133^o$$

Other measurements

$$\overline{Np}_{Ip}=\sum_{i=1}^{n}\frac{Np_{Ip}}{n}=\frac{Np_1+Np_2+.....+Np_n}{n}=\frac{4+.....+4}{40}=3.5/2nerv.\text{sec}.$$

$$\overline{\overline{S}}_{Ip} = \sum_{i=1}^{n} \frac{S_{Ip}}{n} = \frac{S_1 + S_2 + ... + S_n}{n} = \frac{42.19 + ... + 57.12}{40} = 43.78 cm^2$$

$$\overline{\overline{S}}_{Ip} = \sum_{i=1}^{n} \frac{S_{Ip}}{n} = \frac{S_1 + S_2 + ... + S_n}{n} = \frac{42{,}19 + ... + 57{,}12}{40} = 43{,}78 cm^2$$

The size class = Mesophyll

II. Morphometric description of *Ipomoea purpurea*leaves.Laminas obovate to cordate, dominant mesophyll (S = 40.03-78.28 cm²) and subordinatenotofil(S = 23.05-39.66 cm²).In literature (Mouton, 1966a) the leaves size class values are registered as: leptophyll (0-0.25 cm^2), nanophyll (0.25-2.25 cm^2), microphyll (2.25- 20.25 cm²), notophyll (20.25 -40.00 cm²), mesophyll (40.00-182.25 cm^2), macrophyll (182-1640.2 cm^2) and megaphyll (over 1600.2 cm^2).The pubescent laminas are green with a subacute apex (α = 60^o - 120^o), cordate base, entire margin and membranous texture.The petiole is normal, cylindrical,green moderate pubescent and quite long (Lp = 50-125 mm) (Fig. 2).Lamina venation is marginal actinodromous, perfect basal with radial primary veins starting from the base.

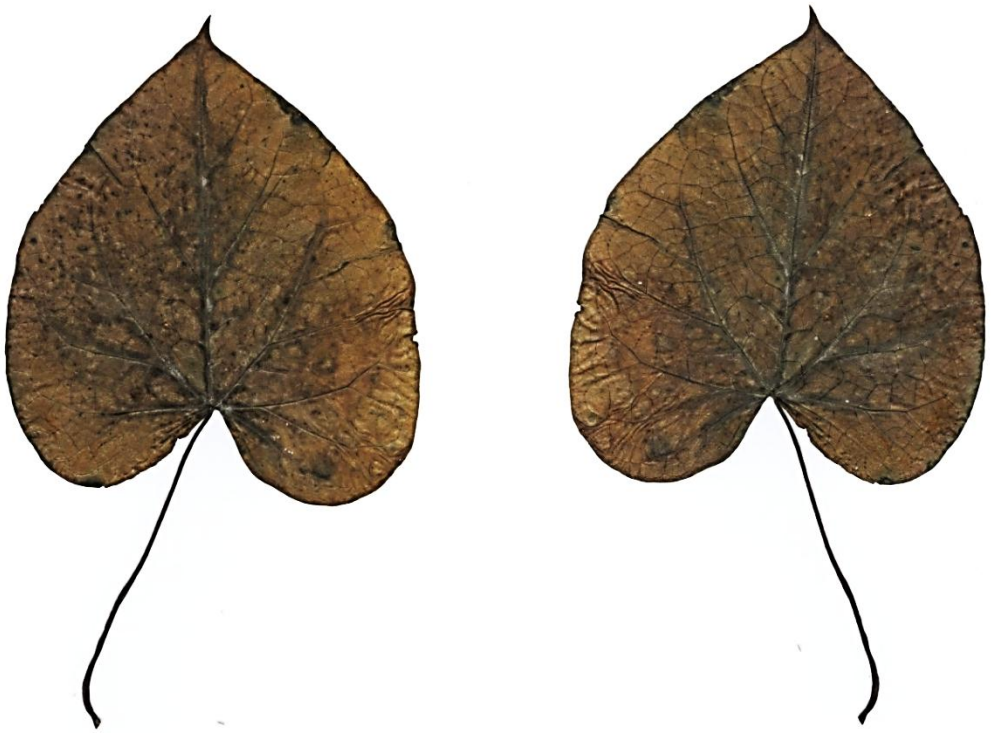


Fig. 2.de *Ipomoea purpurea*leaf: upper surface (left) and lower surface (right).

The emergent angle between the primary and the secondary veins is narrow acute to moderate (β = 30^o – 70^o) (Figs. 1, 2).From the secondary veins start the tertiary veins, more numerous, reaching almost to the edge of the lamina.The emergent angle of the tertiary veins related to the primary one is subacute (ɣ = 30^o– 55^o)(Fig. 2; Tables 1, 2).
The lamina size: L = 61–95 mm; l = 62 – 123 mm

Table 1 Liniar measurements and percentage ratioon *Ipomoea purpur* leaves

Leaf no.	L mm	l mm	h mm	A mm	l-l' mm	Lp mm	L/l %	A/L %	h/L %	A/l-l' %
1	67	94	23	9	25	70	0.71	0.13	0.34	0.36
2	70	74	20	10	15	70	0.94	0.14	0.28	0.66
3	60	64	22	5	17	75	0.98	0.08	0,36	0.29
4	64	62	24	10	15	50	1.03	0.15	0.37	0.66
5	85	95	28	13	22	78	0.89	0.15	0.32	0.59
6	75	74	20	10	16	53	1.01	0.13	0.26	0.62
7	95	123	25	5	13	119	0.70	0.05	0.26	0.38
8	91	113	25	5	19	125	0.80	0.07	0.27	0.36
9	79	90	20	5	9	85	0.87	0.06	0.11	0.55
10	52	80	14	3	10	62	0.65	0.05	0.26	0.30
11	70	71	11	6	6	58	1.00	0.08	0.15	1.00
12	61	62	14	4	7	77	1.00	0.06	0.22	0.57
13	73	83	21	4	7	83	0.87	0.05	0.28	0.57
14	70	76	20	10	17	59	0.92	0.14	0.28	0.58
15	70	78	25	8	16	75	0.89	0.11	0.35	0.50
16	88	100	30	10	23	95	0.88	0.11	0.36	0.43
17	85	94	25	16	18	90	0.18	0.26	0.29	0.88
18	71	81	25	9	18	76	0.87	0.12	0.35	0.50
19	72	86	20	9	20	89	0.83	0.12	0.27	0.45
20	94	99	32	12	21	93	0.94	0.12	0.34	0.57
21	83	112	28	10	30	96	0.74	0.12	0.33	0.33
22	62	72	15	10	15	60	0.86	0.12	0.26	0.66
23	57	63	17	13	19	82	0.90	0.12	0.29	0.41
24	71	72	18	7	18	81	1.00	0.09	0.25	0.38
25	81	97	28	10	20	86	0.83	0.12	0.36	0.50
26	78	82	20	13	19	82	0.95	0.16	0.25	0.68
27	90	67	21	10	17	79	1.34	0.11	0.23	0.58
28	72	83	20	11	15	108	0.86	0.15	0.27	0.73
29	74	80	15	6	10	65	0.92	0.08	0.20	0.06
30	73	89	1.5	5	7	74	0.82	0.06	0.20	0.71
31	54	77	16	3	7	75	0.70	0.05	0.29	0.43
32	82	92	19	5	9	90	0.89	0.06	0.23	0.42
33	61	73	16	5	9	88	0.83	0.04	0.26	0.04
34	82	92	20	6	9	120	0.89	0.04	0.24	0.50
35	93	111	25	5	10	105	0.83	0.03	0.26	0.33
36	66	77	15	4	9	83	0.85	0.08	0.20	0.50
37	67	79	17	8	9	86	0.87	0.04	0.16	0.42
38	82	90	19	5	11	96	0.91	0.06	0.20	0.62
39	98	101	27	5	10	120	1.00	0.04	0.27	0.50
40	87	98	24	5	12	118	0,88	0.05	0.62	0.55

Table 2

***Angular* measurements, other measurements and the size class of *Ipomoea purprea*leaves**

Leaf no.	α°	β°	γ°	ω°	Np	S (cm²)	Size class
1	120	70	45	165	4	42.19	Mesophyll
2	80	50	35	140	4	34.70	Notophyll
3	40	45	35	155	3	25.72	Notophyll
4	65	40	45	150	3	26.58	Notophyll
5	65	30	55	110	4	54.10	Mesophyll
6	65	40	30	145	3	37.18	Notophyll
7	115	50	25	135	3	78.28	Mesophyll
8	100	35	30	150	3	68.89	Mesophyll
9	60	35	25	145	3	47.63	Mesophyll
10	100	45	25	140	3	27.87	Notophyll
11	65	30	35	130	3	33.29	Notophyll
12	75	45	35	95	3	25.33	Notophyll
13	100	40	35	135	4	40.59	Mesophyll
14	90	30	30	140	4	35.64	Notophyll
15	100	40	25	110	3	36.58	Notophyll
16	110	35	30	165	4	58.96	Mesophyll
17	75	60	30	120	4	53.53	Mesophyll
18	100	40	30	130	4	38.53	Notophyll
19	110	40	25	140	3	41.48	Mesophyll
20	90	35	30	155	4	62.35	Mesophyll
21	135	45	30	145	3	62.28	Mesophyll
22	70	50	35	125	3	29.90	Notophyll
23	90	40	25	140	3	24.05	Notophyll
24	100	35	20	125	3	34.25	Notophyll
25	95	35	40	110	4	52.64	Mesophyll
26	85	35	30	130	4	52.64	Mesophyll
27	80	30	40	145	4	40.40	Mesophyll
28	95	30	30	145	4	40.03	Mesophyll
29	90	35	40	105	3	39.66	Notophyll
30	100	30	40	115	3	43.53	Mesophyll
31	100	30	30	125	3	27.85	Notophyll
32	100	35	25	115	4	43.84	Mesophyll
33	120	50	30	130	3	29.83	Notophyll
34	100	30	40	150	4	50.54	Mesophyll
35	115	30	30	160	4	69.16	Mesophyll
36	100	35	45	130	3	34.04	Notophyll
37	105	40	20	150	3	34.56	Notophyll
38	100	35	25	85	4	49.44	Mesophyll
39	110	35	30	135	4	66.31	Mesophyll
40	95	35	20	100	4	57.12	Mesophyll

Table 3

The average of the linear measurements and percentage ratioof *Ipomoea purpurea* leaves

Specia	L (mm)	l (mm)	h (mm)	A (mm)	l-l´ (mm)	Lp (mm)	L/l (%)	A/L (%)	h/L (%)	A/ l-l´ (%)
Ipomaeap urpurea(L.) Roth	75.12	85.15	20.97	7.72	14.22	84.40	0.65	0.09	0.27	0.50

Table 4
Angular measurements and other measurements of *Ipomoea purpurea* leaves

Specia	α˚	β˚	γ˚	ω˚	Np	S (cm²)	Size class
Ipomaea purpurea (L.) Roth	82.75	38.87	32	133	3.50	43.78	Mesophyll

CONCLUSIONS

The linear measurements of *Ipomoea purpurea*laminas have high values concerning the length (L) and lower for the apex length (A). The percentage ratio of *Ipomoea purpurea*leaves indicate a finesse leaf (L/l) and a fine apex (A/I-I'). Lamina venation is marginaactinodromous, perfect basal.Concerningthe leaves angular measurements of *Ipomoea purpurea*,the apex is subacute (α). The basal angle between the primary (ω) veins is obtuse. The emergent angle between the primary and the secondary veins (β)is narrowing acute to moderate whereas the tertiary to the primaries (ɣ) is subacute. The petiole is cylindrical, green and ratherlong (Lp). Laminas have a more or less large surface area (S) including the species leaves in the mesophyll size class and subordinate in notophyll.

The morphological and morphometrical features such as the ovality ratio, the slightly emarginate tip, the membranoustexture, the venation type and the notophyll size class (small surface area with higher leaf mass per unit area) allow *Ipomoea purpurea* to be adaptable for the temperate zones, even with air humidity and semi-arid regions.

The usefulness of this particular study is the fact that this method of investigation and the results may be used in plant taxonomy researches, paleontology, researches concerning the effect of environmental factors as well as in the research of evolution.

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