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ANATOMICAL ALTERATIONS OF *CONVOLVULUS ARVENSIS* L. LEAVES CAUSED BY ERIOPHYOID MITE *ACERIA MALHERBAE* NUZZ.

D. RANČIĆ AND R. PETANOVIĆ

Faculty of Agriculture, Belgrade University, Nemanjina 6, SCG-11080 Zemun

Anatomical alterations of leaves of weed plant *Convolvulus arvensis* L. (Convolvulaceae) caused by eriophyoid mite *Aceria malherbae* Nuzz. are described and quantified. Designated as compatible interaction, they are expressed in dedifferentiation of plant cells, hyperplasia of epidermal layer and their turn to so-called nutritive tissue. Curling of leaf edges emerge as the consequence of mesophyll hypertrophy. It provides protected microhabitat for the huge colony of eriophyoids.

KEY WORDS: *Convolvulus arvensis, Aceria malherbae,* anatomical alterations, eriophyoid mites

INTRODUCTION

Field bindweed, *Convolvulus arvensis* L. is an aggressive perennial weed of Mediterranean and Middle East origin, found throughout temperate regions of the world (HOLM *et al.*, 1977). Field bindweed's long lived seeds and extensive root system make it extremely difficult to control by chemical and mechanical means (ROSENTHAL,1983). In Europe, North and South America, *C.arvensis* is on the list of weeds recommended for biological control. Herbivores and pathogens for use against it have been studied in Europe since 1972 (ROSENTHAL & BUCKINGHAM, 1982).

Among phytophagous mites, eriophyoids are considered to be primary candidates for biological control of weeds because of their ability to suppress plant growth and reproduction and inflict considerable damage to the host plant. Positive aspects of eriophyoid mites include host specificity, wind dispersability, site preference, and selectivity as to food, causing a slow decline of plant vigor.

Large number can be used easily in conjunction with other control agents, e.g. microbial or beneficial insects and will not be competitive with these agents (CROMROY,1979).

Three species of eriophyoid mites have been registered on *C. arvensis: Aceria convolvuli* (Nal.), *A. malherbae* Nuzz. and *Aculus calistegiae* Lamb (AMRINE & STASNY, 1994). Two of them, e.g. *A. convolvuli* and *A. malherbae* have been registered in Serbia and Montenegro (PETANOVIĆ & STANKOVIĆ, 1999). *A. malherbae* has been tested and released in the United States since 1987 (BOLD & SOBHIAN, 1983) and South Africa (CRAEMER,1996).

Only morphological alterations, e.g. leaf furrowing along midrib, abnormal growth of very small tubercles from leaf epidermis and the plant distortion have been described in details (NUZZACI *et al.*, 1985). Galled leaves become yellow-green or red . When mites attack the bud they also prevent natural stem growth and elongation (ROSENTHAL ,1996).

In Serbia *A. malherbae* have been registered in Belgrade region (localities: Radmilovac, Zemun, Novi Beograd, Galovica) and Struganik (PETANOVIĆ & STANKOVIĆ, 1999), Krnule-Vladimirci, Belotić, Šabac, Srpski Miletić (PETANOVIĆ, unpublished).

The aim of the study was to describe and quantify the anatomical alterations provoked by infestation of eriophyoid mite *Aceria malherbae* . Results may help to insight weed plant -mite relationship.

MATERIALS AND METHODS

Anatomy of leaves was described from permanent microscopic preparations. Slides were prepared using standard method for light microscopy (JENSEN,1962, BLAŽENČIĆ,1988). Cross sections of plant material (5-7 μm thick) have been stained afterwards with saphranine and alcian blue. Preparations have been observed under LEICA DMLS microscop. Photographs have been taken using LEICA DC 300 digital camera. In order to define main differences on the anatomical level following characters have been measured: thickness of leaf, high of epidermal cells of upper surface of leaf, thickness of mesophyll and high of epidermal cells of undersurface of leaf. Measurements have been taken using software package IM 1000, comparatively for four zones of each leaf: the leaf edge, central part, close to the main vein and the zone of the main vein. 45 measurements have been done on 15 uninfested and 15 infested leaves. Statistical analysis has been done using programs package SPSS 8.0. For each of mentioned characters main parameters of descriptive statistics have been calculated: mean, minimum, maxi-

mum and standard deviation. Significant differences between infested and uninfested plants were strengthened carrying out unifactorial analysis of variance (ANOVA).

RESULTS AND DISCUSSION

Uninfested leaves of *C. arvensis* are symmetrical dorsoventraly with prominent main vein on cross section (Fig.1). Surface of leaves is covered with one layer of epidermal cells, thick 23-25 μm on upper and 17-18μm on under side, respectively. Mesophyll is thick 110-120μm and differentiated into palisade and spongy tissues (Tab.1).

Table I. Uninfested *Convolvulus arvensis*-descriptive statistics

	Minimum	**Maximum**	**Mean**	**Std. Deviation**
Epidermis of upper surface –leaf base	12.00	37.70	23.90	4.54
Mesophyll- leaf base	61.60	143.80	108.80	22.70
Epidermis of under surface - leaf base	9.60	26.50	17.88	4.24
Epidermis of uppersurface-central part	9.60	38.00	24.20	6.55
Mesophyll-centarl part	72.50	168.60	118.24	25.72
Epidermis undersurface-central part	6.10	27.90	17.45	5.13
Epidermis of upper surface-close to vein	16.70	42.70	25.79	6.27
Mesophyll-close to vein	79.40	166.80	125.48	24.07
Epidermis of undersurface-close to vein	9.20	27.50	18.73	4.76
Epidermis of upper surface-main vein	13.80	39.00	23.16	5.11
Mesophyll-main vein	194.40	320.30	263.23	29.60
Epidermis of under surface- main vein	18.20	33.50	23.59	3.18

On cross sections of infested leaves tissue hypertrophy is observed, most prominent in the zone of the main vein. Hypertrophy and hyperplasia of tissue close to the vein lead to the leaf face to face folding.(Fig. 2). In this zone mesophyll is twice thicker in comparison with uninfested leaves (Tab.II Fig.5). Epidermal cells of undersurface of leaves in the zone of the main vein are extremely large, almost twice larger in comparison with epidermal cells of uninfested leaves. Typical epidermal cells of upper surface of leaves in the zone of the main vein or close by are not observed. Instead, another type of smaller cells are developed in palisade like arrangement (Fig.3). They have dense cytoplasm and prominent nuclei (Fig 4). These cells undergo transverse and longitudinal cleavage and suppose to be nutritive tissue. Nutritive cells serves to feed mites (WESTPHAL *et al*, 1981, ROYALTY & PERRING,1996). According to the classification of symptoms

(WESTPHAL & MANSON,1996) alterations caused by *A. malherbae* can be considered as leaf galls.

Table II. Infested *Convolvulus arvense* leaves-descriptive statistics

	Minimum	Maximum	Mean	Std. Deviation	Stat. Sign. Diff.
Epidermis of upper surface –leaf base	9.30	28.80	18.74	5.65	+
Mesophyll- leaf base	65.30	132.10	101.65	18.41	nssd
Epidermis of under surface - leaf base	8.80	26.10	16.61	4.39	nssd
Epidermis of uppersurface-central part	9.70	34.90	20.50	5.79	+
Mesophyll-centarl part	80.90	216.10	113.48	28.77	nssd
Epidermis undersurface-central part	8.00	29.20	17.91	5.66	nssd
Epidermis of upper surface-close to vein	6.80	27.80	16.19	4.50	+
Mesophyll-close to vein	60.20	446.40	209.32	83.69	+
Epidermis of undersurface-close to vein	15.90	60.70	36.46	10.17	+
Epidermis of upper surface-main vein	4.70	17.10	11.59	3.38	+
Mesophyll-main vein	194.40	407.50	275.65	48.88	nssd
Epidermis of under surface- main vein	19.40	67.00	31.80	10.14	+

Statistically significant differences (p < 0.5) between uninfested and infested leaves are presented in last column with mark +; nssd-no statistically significant differences between uninfested and infested leaves

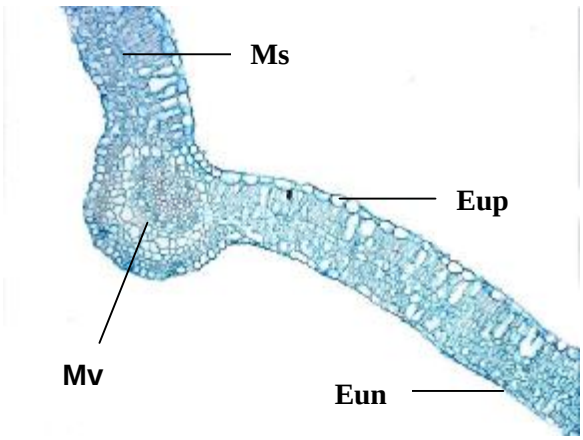

Fig 1. Cross section of uninfested leaf of *Convolvulus arvensis* (x100); Eup-upper epidermis; Eun-under epidermis; Ms-mezophyll; Mv-main vein.

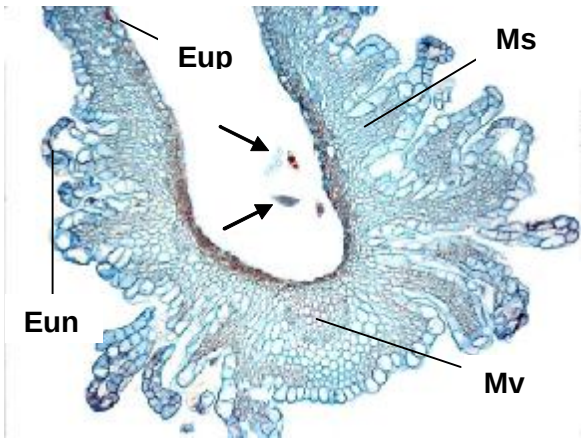

Fig 2. Cross section of infested leaf of *Convolvulus arvensis* (x100); Eup-upper epidermis; Eun-under epidermis; Ms-mezofil; Mv-main vein, Arrow-eriophyid mite

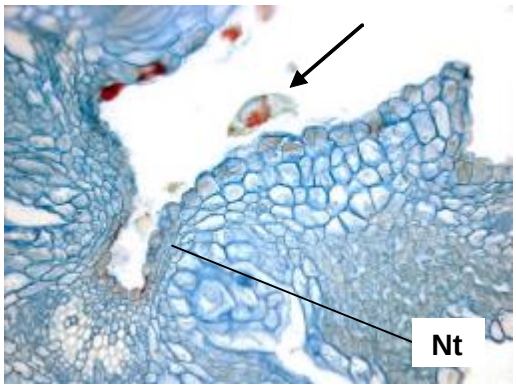

Fig 3. Cross section of infested leaf of *Convolvulus arvensis* (x200); Nt-nutritive tissue; arrow-cross section of the eriphyid mite.

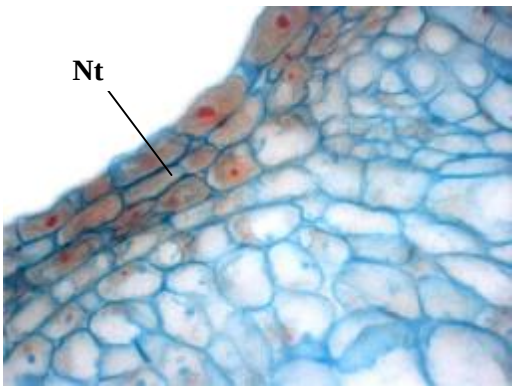

Fig 4. Cross section of infested leaf of *Convolvulus arvensis* (x1000); Nt-nutritive tissue.

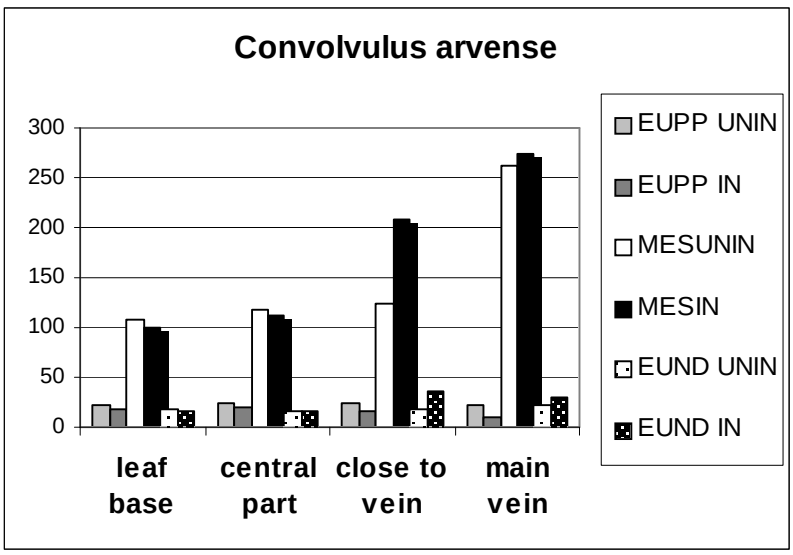

Fig 5. Comparative data of quantitative parameters of infested and uninfested leaves; EUPP UNIN-upper surface epidermis of uninfested leaves; EUPP IN-upper surface epidermis of infested leaves; MESUNIN-mosophyll of uninfested leaves; MESIN-mesophyll of infested leaves; EUND UNIN-undersurface epidermis of uninfested leaves; EUND IN-undersurface epidermis of infested leaves.

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АНАТОМСКЕ ПРОМЕНЕ ЛИСТОВА *CONVOLVULUS ARVENSIS* L. ПРОУЗРОКОВАНЕ ЕРИОФИДОМ *ACERIA MALHERBAE* NUZZ.

Д. Ранчић и Р. Петановић

И з в о д

У раду су описане и квантификоване промене на листовима коровске врсте *Convolvulus arvensis* L. (Convolvulaceae) проузроковане исхраном ериофидне гриње *Aceria malherbae* Nuzz.(Acari:Eriophyoidea). Симптоми који се манифестују увијањем листова се могу уврстити у компатибилне интерекције типа гала. Биљно ткиво на присуство и храњење гриња реагује дедиференцијацијом ћелија и хиперплазијом пре свега епидермалног ткива, при чему настаје нутритивно ткиво којим гриње настављају да се хране. Хипертрофија ткива мезофила доводи до увијања листа , па се тако ствара релативно заштићен простор на лицу листа у коме се развија популација гриња велике бројности.

Добијени резултати доприносе расветљавању интеракције ериофида са биљком домаћином.

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