Vestnik zoologii, **48**(6): 495–502, 2014
DOI 10.2478/vzoo-2014-0059

DE GRUYTER
OPEN

UDC 595.42(477.46)

SPECIES COMPLEXES OF PREDATORY PHYTOSEIID MITES (PARASITIFORMES, PHYTOSEIIDAE) IN GREEN URBAN PLANTATIONS OF UMAN' (UKRAINE)

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Species Complexes of Predatory Phytoseiid Mites (Parasitiformes, Phytoseiidae) in Green Urban Plantations of Uman' (Ukraine). Grabovska, S. L., Kolodochka, L. A. — Structure of species complexes of predatory phytoseiid mites (Phytoseiidae) and their distribution were studied in plant associations of Uman' town (Cherkasy Region, Ukraine). Twelve species of seven genera of phytoseiid mites were revealed. It was observed centripetal reduction of the species diversity in the phytoseiid complexes from the outlying districts to the center of the town.

K e y w o r d s: predatory mites, Phytoseiidae, green urban plantations, Uman', Ukraine.

Видовые комплексы хищных клещей-фитосейид (Parasitiformes, Phytoseiidae) в растительных насаждениях г. Умань (Украина). Грабовская С. Л., Колодочка Л. А. — Исследован видовой состав хищных клещей-фитосейид семейства Phytoseiidae, структура их видовых комплексов и особенности распространения в растительных ассоциациях города Умань Черкасской области (Украина). Обнаружено 12 видов 7 родов клещей семейства. Прослежено уменьшение видового разнообразия этих клещей в направлении от периферии к центру города.

К л ю ч е в ы е с л о в а: хищные клещи, Phytoseiidae, городские насаждения, Умань, Украина.

Introduction

Phytoseiid mites (Parasitiformes, Phytoseiidae) are well known as natural regulators of phytophagous mites and small insects. The predatory arthropods are able to control the number of pests at a low and harmless to plants level under favorable environmental conditions. These resulted in biological balance in plant stands, as biocoenoses are the more stable, the more complex and long-standing organism's trophic relationships exist. Therefore, one of the factors for efficient and sustainable functioning of plant association is the existence of sufficient species diversity and populations magnitude of the phytoseiid mites there. Predatory mite's value is increasing in urban plantations as landscape gardening is one of the simple and generally accepted ways to improve the quality of urban environment, and pesticides treatment for plant pests control is severely restricted in the settlements by the sanitary regulations.

Despite the significant participation of predatory phytoseiid mites in the sustainability of urban plantations, the data on the presence and composition of these arthropods species complexes in towns and settlements are limited, both in local and foreign publications. Generally, they are presented by results of sporadic examinations and fragmentary data in publications devoted to other fields of the phytoseiids investigations (Abbasova, 1972; Kolodochka, 1978; Kuznetsov, Petrov, 1984; Ripka, 1998; Balder et al., 1999). These topics in Ukraine were discussed in some sparse publications regarding Kyiv (Kolodochka, Vasilyeva, 1996; Kolodochka, Samoilova, 2007) and Uman', Cherkasy Region (Kolodochka, Grabovska, 2012). Proposed paper continues the study of arthropods under urban environment conditions.

Material and methods

In 2011 phytoseiid mites were studied during growing season from June, 20 to November, 1. Totally, 34 plant species were surveyed in urban plantations of Uman', Cherkasy Oblast: 28 species of trees and shrubs, including three conifers, and six species of herbaceous plants. There were collected 230 samples. Phytoseiid mites were absent in five of all samples. Other samples revealed 1958 specimens of the phytoseiid mites (1743 ♀ and 215 ♂).

Trees, shrubs and herbaceous plants were examined in the Chernyakhovsky and Shevchenko Parks, the Stadium "Sokil" Park, the Kotovsky Public Garden, in plantings along the streets, near houses and homesteads, etc. Mites were sampled by the method of collecting leaves from different parts of plants crown and placing into plastic bags (20 leaves per crown). Later they were examined under the stereo microscope and mounted on microscopic slides. In addition, another method based on shaking off mites from branches of trees and shrubs, as well as perennial herbaceous plants, onto the black paper or plastic film was used. Mites were transferred then with a dissecting needle into fixing fluid (ethanol 70 %) for preparation of microscopic specimens (Kuznetsov, Petrov, 1984). Mites were mounted using the Hoyer's medium (Cielecka et al., 2009). The system of the phytoseiid mites is accepted according to Kolodochka (2006).

Collection of phytoseiid mites from Uman', Cherkasy Region, gathered in 1971 and deposited in the Acarology Department of the Schmalhauzen Institute of Zoology, NAS of Ukraine (Kyiv) was also studied. It includes plant mites of urban plantations (29 samples, nine species of seven genera of the phytoseiid mites). The data have not previously been published.

Numerical results were processed by the methods of variation statistics. The Jaccard's, Sörensen's, Paliy-Kovnatski's (Di) coefficients and frequency index (IT, %) were calculated. Colonization of plants by mites of particular species was evaluated through the ratio of plant species inhabited by mites to the total number of studied plants (in percentage).

Plants identification is according to Sobko (2009).

Results and discussion

Urban plant communities of Uman' are formed from the park and street plantations of ornamental plants (among which may grow fruit trees), and from plants (mainly orchard plants) of private homesteads of the town. The list of studied plant species is presented in table 1.

The most numerous ornamental trees were Silver Lime, Small-lived Lime, Horse Chestnut, Box Elder, Silver and Norway Maples.

Fruit trees and bushes, such as Sour and Wild Cherry, Cultivated Apple, Common Pear, Apricot, Wild Plum and Cherry Plum, Walnut, Grapes, Raspberry, Black Mulberry, etc., prevail throughout private homesteads.

Examination of green urban plantations during vegetation season of 2011 resulted in finding 12 mite species from seven genera of the family Phytoseiidae: *Amblyseius andersoni* (Chant, 1957); *A. herbarius* (Wainstein, 1960); *A. rademacheri* (Dosse, 1958); *Euseius finlandicus* (Oudemans, 1915); *Kampimodromus aberrans* (Oudemans, 1930); *Dubininellus echinus* (Wainstein et Arutunjan, 1970); *Typhlodromus laurae* Arutunjan, 1974; *Typhloctonus aceri* (Collyer, 1957); *T. tiliarum* (Oudemans, 1930); *Paraseiulus incognitus* Wainstein et Aruunjan, 1967; *P. soleiger* (Ribaga, 1902); *Galendromus longipilus* (Nesbitt, 1951).

The collection of 1971 includes the phytoseiid mites of nine species from seven genera. This collection versus seasonal sampling collection of 2011 does lack the conifer-inhabiting (*Typhlodromus laurae*) and herb-inhabiting (*A. rademacheri, A. herbarius*) species, and relatively rare species (*A. andersoni, Typhloctonus tiliarum* and *G. longipilus*). Meanwhile *Amblydromella halinae* (Wainstein et Kolodochka, 1974), *Am. caudiglans* (Schuster, 1959) and *Neoseiulus reductus* (Wainstein, 1962) are represented in the collection of 1971, that have been found on fruit trees planted in private homesteads at that time, but were not revealed during examination in 2011. This can be explained by vast alterations of natural habitats of those species in the past years as a result of intensive housing development in these part of the town and drastic changes in vegetation of urban landscape.

It should be noted that plants of the "Sofievka" Park, a territory affected by minimum of urbanization, are twice more inhabited by phytoseiid mites (28 species of 12 genera) comparison with others (Kolodochka, Omeri, 2011).

Our study revealed a new evidence of the known fact that plants, even a single species, are unevenly populated by mites (table 1).

Limes of the both species listed in the table 1 are dominating in the urban plantations. Species diversity of the phytoseiid mites reaches up to seven species that is the maximum for the species complexes of phytoseiids in the plant associations of Uman'. In many cases *E. finlandicus* is most abundant in these species complexes. Two to five species of predators

Table 1. Phytoseiid mites on urban plants of Uman'

Таблица 1. Клещи-фитосейиды на городских растениях города Умань

Plant Species	Phytoseiid mites and their complexes occurred on the plant species	Total number of the mite species on one plant
Silver Lime *Tilia tomentosa*	*E. finlandicus*	6
	E. finlandicus + T. aceri	
	E. finlandicus + D. echinus	
	E. finlandicus + T. aceri + D. echinus	
	E. finlandicus + T. aceri + T. tiliarum	
	E. finlandicus + T. aceri + G. longipilus	
	E. finlandicus + T. aceri + D. echinus + T. tiliarum + P. incognitus	
Grapes *Vitis* sp.	*E. finlandicus*	5
	E. finlandicus + T. aceri	
	E. finlandicus + K. aberrans + D. echinus + P. incognitus	
Walnut *Juglans regia*	*A. andersoni*	5
	E. finlandicus	
	E. finlandicus + T. aceri	
	E. finlandicus + T. aceri + T. tiliarum	
	E. finlandicus + P. incognitus	
Box-elder *Acer negundo*	*E. finlandicus*	5
	T. aceri	
	E. finlandicus + P. soleiger	
	E. finlandicus + T. aceri	
	E. finlandicus + T. aceri + T. tiliarum + P. incognitus	
	T. aceri + T. tiliarum	
Cultivated Apple *Malus domestica*	*E. finlandicus*	5
	D. echinus	
	K aberrans	
	T. tiliarum	
	E. finlandicus + K. aberrans	
	E. finlandicus + D. echinus	
	E. finlandicus + D. echinus + T. aceri	
	E. finlandicus + T. aceri + T. tiliarum + D. echinus	
Sour Cherry *Cerasus vulgaris*	*E. finlandicus*	4
	E. finlandicus + P. incognitus	
	E. finlandicus + K. aberrans	
	E. finlandicus + P. incognitus + T. aceri	
Norway Maple *Acer platanoides*	*E. finlandicus*	4
	E. finlandicus + K. aberrans	
	E. finlandicus + T. aceri	
	E. finlandicus + T. tiliarum	
	E. finlandicus + T. aceri + T. tiliarum	
	E. finlandicus + T. tiliarum + K. aberrans	
Small-lived Lime *Tilia cordata*	*E. finlandicus*	4
	K. aberrans	
	E. finlandicus + K. aberrans	
	E. finlandicus + T. aceri	
	E. finlandicus + T. tiliarum	
	E. finlandicus + T. tiliarum + T. aceri	
	T. aceri + K. aberrans	
Common Hazel *Corylus avellana*	*E. finlandicus*	4
	P. soleiger	
	E. finlandicus + P. soleiger	
	E. finlandicus + T. aceri + T. tiliarum	

Wild Plum *Prunus domestica*	*A. andersoni*	4
	A. andersoni + D. echinus	
	E. finland icus + T. tiliarum	
Quince *Cydonia oblonga*	*E. finlandicus + K. aberrans + P. incognitus*	3
Apricot *Armeniaca vulgaris*	*E. finlandicus*	3
	T. tiliarum	
	E. finlandicus + P. incognitus	
	E. finlandicus + T. tiliarum	
White Ash *Fraxinus americana*	*E. finlandicus*	3
	E. finlandicus + T. aceri + P. incognitus	
Cherry Plum *Prunus divaricata*	*E. finlandicus*	2
	E. finlandicus + D. echinus	
European White Elm *Ulmus laevis*	*E. finlandicus*	2
	E. finlandicus + T. aceri	
Knapweed *Centaurea* sp.	*E. finlandicus + A. rademacheri*	2
Hornbeam *Carpinus betulus*	*E. finlandicus*	2
	E. finlandicus + T. aceri	
Mountain Ash *Sorbus aucuparia*	*E. finlandicus*	2
	E. finlandicus + D. echinus	
Annual Nettle *Urtica urens*	*A. herbarius*	2
	P. incognitus	
Guelder-rose *Viburnum opulus*	*E. finlandicus*	2
	E. finlandicus + K. aberrans	
Silver Maple *Acer saccharinum*	*E. finlandicus*	2
	E .finlandicus + T. aceri	
Black Mulberry *Morus nigra*	*E. finlandicus*	2
	E. finlandicus + T. tiliarum	
Wild Cherry *Cerasus avium*	*E finlandicus*	2
	E. finlandicus + D. echinus	
Cossack Juniper *Juniperus sabina*	*E. finlandicus + A. andersoni*	2
Common Elder *Sambucus nigra*	*A. andersoni*	1
Common Pear *Pyrus communis*	*E. finlandicus*	1
Thornapple *Datura stramonium*	*A. andersoni*	1
Male Fern *Dryopteris filix-mas*	*E. finlandicus*	1
Purple Echinacea *Echinacea purpurea*	*E. finlandicus*	1
Horse-chestnut *Aeculus hippocastanum*	*E. finlandicus*	1
Mallow *Malva* sp.	*E. finlandicus*	1
Raspberry *Rubus idaeus*	*A. andersoni*	1
White Cedar *Thuja occidentalis*	*T. laurae*	1
Colorado Spruce *Picea pungens*	*T. laurae*	1

are able to inhabit various combinations on one lime plant simultaneously, regardless of its species.

The same regularities are observed on other studied species of plants, but the number of predatory mite species in their species complexes is much less.

Five species of phytoseiids were found on each plant species of Grapes, Walnut, Box-Elder and Cultivated Apple.

Mites of the species *E. finlandicus* often live on Grapes. The presence of multispecies complexes of phytoseiids on this plant is, probably, an exception. From this point of view, revealing of a specimen of *Typhloctonus aceri* on Grapes is casual.

Walnut is also a location for both mite species, *E. finlandicus* or *A. andersoni,* and the phytoseiid mite complexes.

Typhloctonus aceri is frequently present on Box-Elder, although there are cases of its "substitution" by *E. finlandicus.* Other species of phytoseiid mites occur as a part of species complexes.

D. echinus was a widespread species of the phytoseiids on Cultivated Apple (IT = 69.2 %).

Four species of mites have been found accordingly on each plant species of Sour Cherry, Norway Maple, Common Hazel and Wild Plum, where the species *E. finlandicus* occurs predominantly in most samples.

Three species of mites were found on each plant species of Quince, Apricot and White Ash. Two species were registered on each plant species of Cherry Plum, European White Elm, Hornbeam, Annual Nettle, Guelder-Rose, Silver Maple, Mountain Ash, Black Mulberry, Whild Cherry and Juniper. Only one species of mites was found on each of the plant species of Common Elder, Common Pear, Thornapple, Echinacea, Horse-Chestnut, Mallow, Raspberry, Male Fern and White Cedar and Colorado Spruce.

As demonstrated in the table 2, *E. finlandicus* is predominant in the species complexes of phytoseiid mites in plant associations of Uman' by number of inhabited plant species (fig. 1), absolute number of predatory mite specimens in the samples and the occurrence coefficient (Di = 60.32 %). Thus, this species prevails in most of the complexes. Presented data show a weak connection between above mentioned mite species and inhabited plants. However, *E. finlandicus* has distinct specialization to trees and shrubs. Minor changes in the abundance of this species in the direction from the outlying districts to the urban core indicate its high tolerance to the influence of negative factors in urban environment.

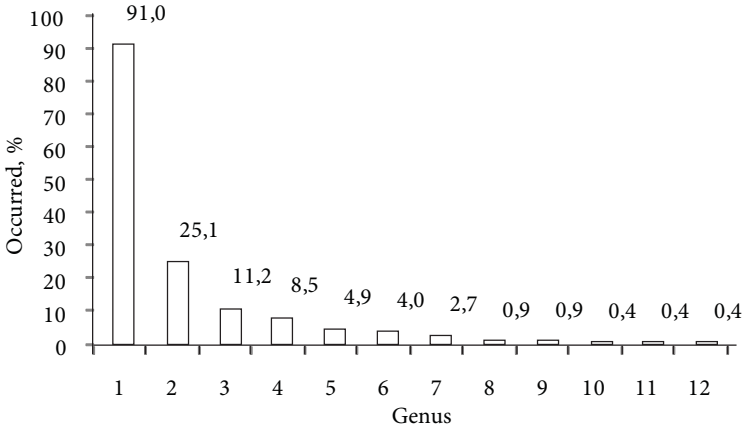

Fig. 1. Percentage of the phytoseiid species identified in collection from the urban plantations of Uman': 1 — *E. finlandicus,* 2 — *T. aceri,* 3 — *T. tiliarum,* 4 —*D. echinus,* 5 — *K. aberrans,* 6 — *P. incognitus,* 7 — *A. andersoni,* 8 — *P. soleiger,* 9 — *T. laurae,* 10 — *A. herbarius,* 11 — *G. longipilus,* 12 — *A. rademacheri.*

Рис. 1. Доля выявленных видов клещей-фитосейид в коллекции из растительных насаждений г. Умань: 1 — *E. finlandicus*, 2 — *T. aceri*, 3 — *T. tiliarum*, 4 — *D. echinus*, 5 — *K. aberrans,* 6 — *P. incognitus*, 7 — *A. andersoni*, 8 — *P. soleiger*, 9 — *T. laurae*, 10 — *A. herbarius*, 11 — *G. longipilus,* 12 — *A. rademacheri.*

Table 2. Main ecologic and faunistic characteristics of phytoseiid mites from green urban plantations in Uman'

Таблица 2. Основные экологические и фаунистические характеристики клещей-фитосейид растительных насаждений города Умань

Species	Number of plant species inhabited by phytoseiids (to the total number of examined plant species. %)	Total mites in samples. specimens	Frequency. %	Paliy-Kovnatski's coefficient (Di), %
E. finlandicus	28 (82.35)	1298	91.0	60.32
T. aceri	13 (38.23)	112	25.1	1.43
T. tiliarum	10 (29.41)	44	11.2	0.25
D. echinus	7 (20.58)	67	8.5	0.29
K. aberrans	6 (17.64)	24	4.9	0.06
P. incognitus	8 (23.52)	13	4.0	0.02
A. andersoni	5 (14.70)	22	2.7	0.03
P. soleiger	2 (5.88)	3	0.9	0.013
T. laurae	2 (5.88)	20	0.9	0.09
A. herbarius	1 (2.94)	1	0.4	0.002
G. longipilus	1 (2.94)	1	0.4	0.002
A. rademacheri	1 (2.94)	2	0.4	0.004

Typhloctonus aceri (Di = 1.43 %) that mostly live on different species of Maples is a subdominant in the species complexes of phytoseiid mites. *Typhloctonus tiliarum* and *D. echinus* (Di = 0.25 %, Di = 0.29 %) are the subdominants of the first order. Other species are secondary members of predatory mites associations.

The presence of biotopic specialization of different level for some predators is evident during evaluation of data on colonization of plant species by the phytoseiid mites. Biotopic specialization is varying from the weak one, as for *E. finlandicus*, up to quite evident.

For example, among reveled species most specialized for dwelling herbaceous plants are mites of *A. herbarius*, which were found only on Annual Nettle. Representatives of *A. rademacheri* were collected only on Knapweed, *G. longipilus* were presented only on Silver Lime, *P. soleiger* were found on Common Hazel and Box-Elder, and *Typhlodromus laurae* were on Colorado Spruce and White Cedar. Figure 2 illustrates the dominance of the species *E. finlandicus* in all complexes of phytoseiid mites in plantations of Uman'. Mites of the species *Typhloctonus aceri* are on the second place. Due to specialization on the genus *Acer*, these predators achieve high levels of abundance in plant associations with predominance of different species of Maples.

There were found seven species of mites that form the main body of the phytoseiid species complex on plants in urban associations, namely: *E. finlandicus, Typhloctonus aceri, T. tiliarum, D. echinus, K. aberrans, P. incognitus* and *A. andersoni.* Other species have frequency index less 1 % that indicates their relatively minor role in urban vegetation.

Thus, the predatory phytoseiid mites of 12 species from seven genera were revealed on the plants of urban green plantations in Uman'. On the town outskirts, where private homesteads prevail and fruit trees and bushes are more common, 10 species of these predators are observed (*E. finlandicus, Typhloctonus aceri, T. tiliarum, D. echinus, K. aberrans, P. incognitus, A. andersoni, A. rademacheri, A. herbarius, Typhlodromus laurae*). Nine species (*E. finlandicus, Typhloctonus aceri, T. tiliarum, D. echinus, K. aberrans, P. incognitus, Typhlodromus laurae, P. soleiger, G. longipilus*) were found in the town parks (the Chernyakhovsky and Shevchenko Parks, the Stadium "Sokil" Park) and in the Kotovsky Public Garden. Only 7 species of arthropods (*E. finlandicus, Typhloctonus aceri, T. tiliarum, D. echinus, Typhlodromus laurae, P. incognitus, P. soleiger*) were collected in the green stands along the streets of the urban core.

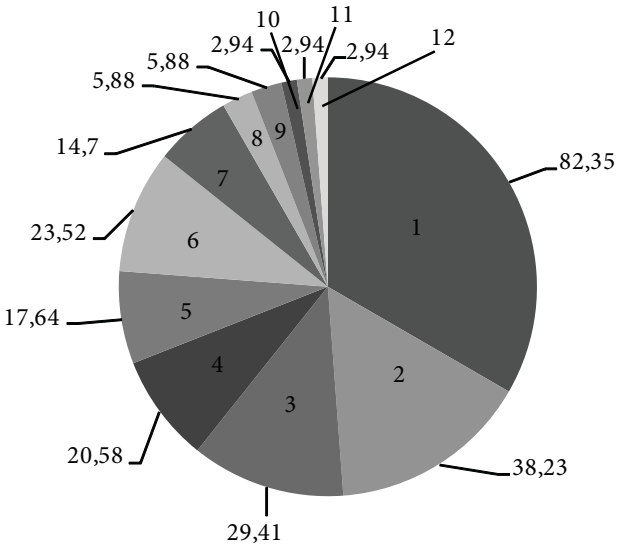

Fig. 2. Phytoseiid mites occurrence on plants in green urban plantations of Uman': 1 — *E. finlandicus,* 2 — *T. aceri,* 3 — *T. tiliarum,* 4 — *D. echinus,* 5 — *K. aberrans,* 6 — *P. incognitus,* 7 — *A. andersoni,* 8 — *P. soleiger,* 9 — *T. laurae,* 10 — *A. herbarius,* 11 — *G. longipilus,* 12 — *A. rademacheri.*

Рис. 2. Встречаемость клещей-фитосейид на растительных зелёных насаждениях г. Умань: 1 — *E. finlandicus*, 2 — *T. aceri*, 3 — *T. tiliarum*, 4 — *D. echinus*, 5 — *K. aberrans*, 6 — *P. incognitus*, 7 — *A. andersoni*, 8 — *P. soleiger*, 9 — *T. laurae*, 10 — *A. herbarius*, 11 — *G. longipilus*, 12 — *A. rademacheri.*

The predatory phytoseiid mites of 28 species 12 genera are known in the "Sofievka" Park, located in the outlying district of the town and characterized by plant communities composed of alien plant species in addition to the species of local flora (Kolodochka, Omeri, 2011). Only 11 species from them were found in the town during this study, most of the other species (17) are not detected in samples of urban plants, namely *Amblyseius maior* (Karg, 1970); *A. obtusus* (Koch, 1839); *Amblyseiulus okanagensis* (Chant, 1957); *Neoseiulus reductus* (Wainstein, 1962)*; N. umbraticus* (Chant, 1956)*; K. corylosus* Kolodochka, 2003; *Typhlodromus cotoneastri* Wainstein, 1961; *T. ernesti* Ragusa et Swirski, 1978; *T. pritchardi* Arutunjan, 1971; *T. rodovae* Wainstein et Arutunjan, 1968; *Anthoseius (Mumaseius) victorovi* Wainstein, 1975; *Amblydromella* (s. str.) *caudiglans* (Schuster, 1959); *A.* (s. str.) *halinae* (Wainstein et Kolodochka, 1974); *A.* (s. str.) *inopinata* (Wainstein, 1975); *A.* (s. str.) *rhenana* (Oudemans, 1905); *A. (Aphanoseia) clavata* (Wainstein, 1972); *A. (Aphanoseia) verrucosa* (Wainstein, 1972). Therefore, the arboretum is a refuge for the phytoseiid species that have an opportunity to spread onto plants of adjacent territories of urban landscape under certain conditions of ecological situation improvement in the city.

Conclusions

The analysis of data indicates there is rather low level of species diversity of the predatory phytoseiid mites in the urban core, where the negative human impact on plants and animals is the highest, compared to that in the outskirts. It is due rather to limited composition of plant species that are cultivated in the parks, gardens and along the streets. In addition, formation of less diverse species composition of phytoseiid mites in the urban core is a result of general escape of species more sensitive to other factors of urban environment (of air humidity, pollution of air by dust and toxic gases in the town, etc.). Eurytopic species *E. finlandicus* is predominant in species complexes of phytoseiid mites in plant associations of Uman' by number of inhabited plant species, absolute number of individuals in mixed populations of predatory mites and high index of frequency.

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Received 27 November 2013
Accepted 24 September 2014