# THE EVALUATION OF TOXICITY IN ORNAMENTAL PLANTS – ELEMENT IN ECOLOGICAL LANDSCAPE DESIGN

## EVALUAREA TOXICITĂȚII PLANTELOR ORNAMENTALE – ELEMENT ÎN PROIECTAREA ECOLOGICĂ

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***Abstract***. *Ornamental plants can create allergenic, irritative and toxic diseases. The knowledge of potentially toxic plants is a public health issue. This paper aims to study the unwanted effects of ornamental plants on health, correlated with the presence of these plants in parks and gardens. The main research methods used were: bibliographical study, analysis and synthesis of data, collection and processing of statistical and legislative data, case-centered analysis. The information was provided by scientific literature. The analysis units were green urban spaces in Iasi. The paper centralizes the potentially pathogenic effects of ornamental plants, exemplifying with herbaceous and ligneous vegetation present in Romanian flora. Urban landscapes in Iasi were evaluated from an ambient health perspective. In the structure of landscape designs it is recommended to avoid the use of highly allergenic and toxic species. It is necessary for different designing programmes to consider the impact on health.*
***Keywords***: *proiectare, biosecuritate, plante toxice*

***Rezumat***. *Plantele ornamentale pot produce afecțiuni alergenice, iritative şi toxice. Cunoaşterea plantelor cu potențial toxic constituie o problemă de sănătate publică. Scopul lucrării este de a studia efectele nedorite ale plantelor ornamentale asupra sănătății, corelat cu prezența acestor plante în compoziții peisagere. Principalele metode de cercetare abordate au fost: studiul bibliografic, analiza şi sinteza datelor, colectarea şi analiza datelor statistice şi legislative, analiza centrată pe caz. Informațiile au fost furnizate de literatura de specialitate. Unitățile de analiză au fost reprezentate de spații verzi din Iaşi. Lucrarea centralizează efectele potențial patogene ale plantelor ornamentale, exemplificând cu vegetație erbacee şi lemnoasă prezentă în flora României. Amenajări urbane din Iaşi sunt evaluate din punct de vedere al sănătății ambientale. In compoziția spațiilor verzi se recomandă evitarea utilizării speciilor de mare alergenitate şi toxicitate. Este necesar ca diferitele programe de proiectare să ia în considerare impactul asupra sănătății.*
***Cuvinte cheie***: *landscape design, biosecurity, toxic plants*

## INTRODUCTION

Wellbeing is a delicate balance between healthy human processes (psychological, physical, spiritual) and healthy environments (landscapes, weather, build environment, social circumstances). Carefully designed garden

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environments can help maintain the balance necessary for the healthy life (Johnson and Johnson, 2012).

Vegetation is an important component used in landscape design that blends beauty with environmental benefits. However, most plants are toxic to a degree and planning a garden with only zero-risk plants would probably be impossible. Plant toxicity must be kept in perspective. Ornamental plants can act as hazardous when eaten, touched or inhaled. Basically, plants cause harm through some mechanisms: irritation (mechanical or chemical), toxicity and allergenicity. Sometimes, different mechanisms can act together (Crosby, 2004).

This paper aims to overview common ornamental shrubs and trees from Romania with hazardous potential. Urban landscapes in Iasi were evaluated from an ambient health perspective and potential dangerous plants were emphasized.

## MATERIALS AND METHOD

This paper synthesized commonly hazardous outdoor plants, used and popular in Romania. Their risk potential to human health was discussed. Vegetal structure of landscape from Iasi was evaluated from a health perspective. The research methods used were bibliographical study, literature review and synthesis, collection and processing of data, comparative analysis. The biological material considered included representative trees, shrubs, climbers and some herbaceous ornamentals.

## RESULTS AND DISCUSSIONS

Outdoor plants could be dangerous in special circumstances related to the plant, way of exposure and potential victim (Crosby, 2004; Piirilia, 1994). Usually, undesired effects are registered by accident. Testing on humans solely for hazard identification purposes is generally not acceptable.

Hazardous plant parts or plant constituents represent effective defence against predatory animals or an expression of environmental adaptation. Plants present protective structures which could be harmful for humans and animals. These structures are classified by botanists in four classes: thorns, spines, prickles and epidermal hairs. Chemical compounds from secondary metabolism act as chemical protection. These active principles belong to different chemical classes and are species related. Their role in plant life is complex and incompletely known (Capon, 2010).

Morphological structures (Capon, 2010) and chemical compounds (Ciulei *et al*., 1993) which can be harmful for humans and animals are tabulated (tab. 1). The basic effects on human health are mentioned.

Poisonings and deaths from ornamental outdoor plants are rare. However, as Johnson (2006) emphasized, it is better to know which plants are potentially dangerous. Small children are often at risk from coloured berries, leaves and petals. Gardening could be a risk factor for allergic sufferers and some plants are known to produce hay fever, asthma or allergic contact dermatitis (Crosby, 2004; Esch, 2001; Huntington, 1999).

*Table 1*

**Common outdoor plant constituents hazardous for human health**

| Type | Class | Typical elicitors | Health effects |
|---|---|---|---|
| 1. Morphological structures | thorns | *Crataegus* sp. | - wounds<br>- irritant urticaria<br>- irritant dermatitis |
| | spines | *Ilex* sp. | |
| | prickles | *Rosa* sp. | |
| | epidermal hairs | *Urtica* sp. | |
| | sharp leaves | *Cortaderia sp.* | |
| 2. Chemical compounds:<br>2.1 Toxic | peptides | *Ricinus communis* | - systemic toxicity or target organ specific effect (neuro, cardio, vascular, nephro, hepato, gastrointestinal, immune, respiratory, blood, reproductive);<br>- carcinogenic |
| | alkaloids | *Taxus baccata* | |
| | glycosides | *Prunus* sp. | |
| | tannins | *Quercus* sp.<br>*Robinia* sp. | |
| | isoprenoides | *Chrysanthemum* sp. | |
| | phenols & derivates | *Salix* sp. | |
| 2.2 Sensitizers | quinones | *Betula pendula* | - skin sensitization (allergic contact dermatitis/ urticaria);<br>- eye damage;<br>- respiratory sensitization (airborne allergens) |
| | lactones | *Tulipa* sp.<br>*Chrysanthemum* sp. | |
| | urushioids | *Ginkgo biloba* | |
| | essential oils | *Rosa damascena;*<br>*Lavandula angustifolia;*<br>*Juniperus virginiana* | |
| | resins | *Thuya plicata* | |
| | acetylenic alcohols | *Hedera helix* | |
| 2.3 Irritants | esters | *Daphne* sp. | - skin and mucosal damage;<br>- irritant urticaria/ dermatitis;<br>- eye irritation/ eye damage |
| | organosulfur-compounds | *Brassica* sp. | |
| | calcium oxalates | *Parthenocissus* sp. | |
| 3. Pollen grains | trees | *Acer* sp., *Betula* sp.<br>*Platanus* sp. | - respiratory allergy (asthma, hay fever) in sensitised people |
| | shrubs | *Buddleja* sp.<br>*Ligustrum* sp. | |
| | grasses | *Cortaderia selloana* | |
| | herbaceous plants | *Amaranthus* sp. | |

Male trees and shrubs of some species (*Fraxinus, Acer, Ilex*) produce large amounts of pollen. It is recommended to avoid them (Quyang et al, 2007). Hazardous common ornamental plants from Romania are listed in table 2.

*Table 2*

**Hazardous common ornamental plants**

| Hazardous class | Potential risk | Typical species |
|---|---|---|
| Trees | toxic (ingested) | *Ailanthus altissima, Betula pendula, Thuya* sp., *Salix* sp. |
| | toxic and dermal sensitizer | *Acer* sp., *Fraxinus* sp., *Quercus* sp., *Juglans* sp., *Populus* sp., *Platanus* sp. |
| | allergenic through pollen (inhaled) | *Aesculus* sp., *Tilia tomentosa, Prunus* sp., *Robinia pseudoacacia, Laburnum sp.* |
| Shrubs | toxic (ingested) | *Berberis* sp., *Taxus baccata, Cytisus scoparius, Cotoneaster* sp., *Juniperus* sp., *Ilex* sp., *Ligustrum vulgare, Viscum album, Sambucus* sp. |
| | sensitizer (dermal/eye contact) | *Thuya plicata, Juniperus* sp., *Cornus* sp., *Hydrangea macrophylla, Ligustrum vulgare, Rhus* sp., *Ceanothus* sp. |
| | allergenic through pollen (inhaled) | *Ligustrum vulgare, Syringa vulgaris, Buddleya davidii* |
| | fragrances (inhaled) | *Rosa* sp., *Lavandula angustifolia, Philadelphus* sp. |
| Climber | toxic and sensitizer (ingested/contact) | *Hedera helix, Clematis* sp., *Parthenocissus* sp., *Wisteria sinensis, Lonicera japonica* |
| | allergenic (pollen, inhaled) | *Wisteria sinensis* |
| Ornamental grasses | allergenic (inhaled or dermal contact) | *Cortaderia selloana, Stipa gigantea, Phalaris arundinacea, Festuca glauca* |
| Herbaceous ornamentals | toxic (ingested) | *Ricinus communis, Colchicum autumnale, Delphinium* sp., *Convallaria majalis, Ipomoea* sp., *Anemone nemorosa, Arum maculatum, Lupinus* sp. |
| | sensitizers (contact/inhaled) | *Chrysanthemum* sp., *Primula* sp. |
| | allergenic through pollen | *Amaranthus caudatus* |

Iasi city has approximately 912 hectars of planted green areas. Sandu, Trofin and Bernardis (2012) assess the structure of ornamental vegetation in Iasi in a 10-year study. According to the general structure's evaluation, the authors found 47% deciduous trees, 29% deciduous shrubs, 15% resin tree and 9% resin shrubs from existing ornamental plants. The dominant species for all green spaces in Iasi are listed in table 3.

According to the authors, street plantations are 99% composed of deciduous trees, especially from the following genus: *Tilia, Acer, Robinia, Quercus, Populus, Juglans*. Recreational areas have the following dominant

genus: *Acer, Quercus, Fraxinus (F. excelsior), Robinia (R. pseudoacacia), Tilia.* There are also frequently planted gymnosperm shrubs as *Taxus baccata*, which present ornamental and pollution resistance value. There is no mention about the sex of the plants registered.

*Table 3*

**Dominant vegetal species in Iasi urban landscapes (after Sandu *et al.*, 2012)**

| Class | Genus | Common species |
|---|---|---|
| Trees | *Tilia* | *T. tomentosa, T. cordata, T. plathyphyllos* (lime, linden, basswood) |
| | *Acer* | *A. platanoides, A. pseudoplatanus* (maples) |
| | *Quercus* | *Q. robur, Q. pedunculiflora, Q. petracea* (oaks) |
| | *Populus* | *P. canadensis,P. alba* (poplars) |
| | *Robinia* | *R. pseudoacacia* (black locust) |
| | *Pinus* | *P. sylvestris* (forest pine), *P. nigra* (black pine) |
| | *Thuja* | *T. occidentalis 'Fastigiata'* (arbovitae) |
| Shrubs | *Thuja* | *T. orientalis* |
| | *Spiraea* | *S. vanhouttei* (honeysuckle) |
| | *Rosa* | different species and cultivars (roses) |
| | *Cornus* | *C. sanguinea* (silver carp) |
| | *Buxus* | *B. sempervirens* (boxwood) |
| | *Syringa* | *S. vulgaris* (lilac tree) |
| | *Ligustrum* | *L. vulgare* (privet) |
| | *Forsythia* | *Forsythia* sp. (forsythia) |

The analysis of vegetal structures from Iasi landscape (tab. 3) emphasised the presence of highly allergenic species (*Fraxinus excelsior, Acer* sp., *Tilia tomentosa*, *Quercus* sp., *Populus* sp., *Juglans* sp., *Ligustrum vulgare*) (tab. 2). Toxic species are also used in public spaces: *Robinia pseudoacacia, Taxus baccata* (tab. 2). Other studies are needed to correlate the vegetal structures in Iasi green spaces and the incident of allergic respiratory diseases.

## CONCLUSIONS

1. Undertaking research on the criteria used to select plants for urban environment is a public health problem. Nuisance factors must be considered (including shedding bark and other morphological structures, unpleasant odours and poisonous and allergenic properties).

2. Urban landscape strategy must exclude plants which are dangerous for children from spaces used by them. Moreover, allergenic trees and shrubs and allergenic herbaceous ornamentals which are known to cause asthma or hay fever must be avoided. Low allergenic species are recommended.

3. Vegetal structure in landscape from Iasi reflects a high presence of allergenic plants. Allergenic trees are dominant.

4. Landscape design must be friendly, low-allergenic and low-poisonous, with a minimum of hazardous elements taken into account, so as to ensure biosecurity in human environments.

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