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# First record of alien species *Toxicodendron radicans* (Anacardiaceae) in Lithuania

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**Abstract**

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In the summer of 2025, a population of *Toxicodendron radicans* (L.) Kuntze, commonly known as eastern poison ivy, was discovered growing behind the Kaunas Botanical Garden in Lithuania. The discovered population of *Toxicodendron radicans* was observed occupying two contrasting habitat types: grassland and a nearby woodland. A negative relationship was found between *Toxicodendron radicans* coverage and plant species richness in both habitats ($r_s = –0.62$; $p < 0.05$). The coverage of *Toxicodendron radicans* and other plant species in the grassland showed a strong negative relationship ($r_s = –0.95$; $p < 0.001$). In contrast, this relationship was weak and not significant in woodland habitat ($r_s = –0.22$; $p = 0.34$). This finding represents the first verified record of the species in the country and constitutes the northernmost documented record of its casual presence in Europe. It also underscores important concerns regarding the role of botanical gardens as potential hubs for the introduction and establishment of alien plant species. The detection of *Toxicodendron radicans* in Kaunas underscores the need for rigorous monitoring, risk assessment, and management measures within and around botanical gardens to prevent the unintentional spread of potentially harmful or allergenic species into surrounding ecosystems.

**Keywords**: botanical garden, naturalisation, poison ivy, shrub, vine.

## INTRODUCTION

The spread of alien plants has accelerated in recent years. The number of alien flora varies by country, yet recent updates show the same increasing trend across all countries throughout Europe (Kalusová et al., 2024). A thorough understanding of the composition and structure of the alien species pool in a certain area provides a vital foundation for multiple aspects of plant invasion research and its practical applications (Fernandes et al., 2025). Therefore, floristic records are crucial for strengthening national plant inventories and closing gaps in global biodiversity databases (Meyer et al., 2016).

The Anacardiaceae family comprises about 77 genera and 600 species, distributed mainly in tropical and subtropical areas, with a few species distributed in temperate regions. Several species within the family are economically important, with some also valued as ornamentals (Pell et al., 2010). In Europe, 18

Anacardiaceae species are not native, of which four are listed as invasive plants (Kalusová et al., 2024). The expanding presence of these taxa warrants attention not only for ecological reasons but also for public health considerations, as plants containing toxic compounds may impact human health in various ways. For example, ingestion can lead to systemic poisoning, while direct contact with certain species can cause dermatitis due to irritant or allergenic chemicals (Lazzaro et al., 2018). In North America, plants of the genus *Toxicodendron* are well known as poison ivy or poison oak, and can cause serious health problems. Urushiol, present in the leaves, stems, roots, and berries of all *Toxicodendron* species, can elicit allergic contact dermatitis in approximately 50–75% of individuals (Kim et al., 2019). In areas where *Toxicodendron radicans* is widespread, it is a major medical concern; in the United States, it causes dermatitis in millions of people annually (Kim et al., 2019).

Taxonomy of this genus has also been a concern, as plants of this genus are variable even at the species level. *Toxicodendron radicans* has been frequently confused with several other plant species found within its native range and in Europe, particularly *Acer negundo* L. and *Parthenocissus quinquefolia* (L.) Planch. (Gillis, 1971; Matthews et al., 2015). Despite the popular mnemonic "Leaves of three, let it be," the considerable taxonomic and morphological variation in *Toxicodendron radicans,* along with the presence of many non-allergenic species with similar trifoliate leaves, makes accurate identification difficult, contributing to frequent misidentification and high rates of allergenic dermatitis within its native range (Jelesko et al., 2024). Moreover, the species can adopt several growth forms – shrub, liana or creeping, which complicates its identification (Resler et al., 2022).

A risk assessment of *Toxicodendron radicans*, focusing on its potential occurrence in the Netherlands, has been conducted by Matthews et al. (2015). The assessment relies mainly on North American research and a small number of surveys conducted in various European countries. Subsequent publications have reported additional occurrences, suggesting a continuing spread, or at least persistence of this species across Europe (Vojík et al., 2020; Galasso et al., 2022; Pax & Antoine, 2023; Koniakin et al., 2024).

During a field survey conducted around botanical gardens in Lithuania, a population of *Toxicodendron radicans* was discovered in Kaunas, Central Lithuania. A further inspection revealed an additional patch occurring in a different habitat type. We assessed the influence of this species on the plant species diversity of the communities at these newly identified sites. This study presents the first record of *Toxicodendron radicans* in Lithuania, likely the northernmost casual occurrence of the species in Europe. Previous occurrences of *Toxicodendron radicans* in Europe were also discussed. The aim of this study was to document the occurrence and habitat preferences of *Toxicodendron radicans* in Lithuania, assess its potential ecological impact on native plant communities and analyse this record within a European context of alien plant introductions.

## MATERIALS AND METHODS

### Study species

***Toxicodendron radicans*** (L.) Kuntze, Revis. Gen. Pl., 1: 153. 1891. – *Rhus radicans* L., Sp. Pl., 1: 266. 1753. – *Philostemon radicans* (L.) Raf., Fl. Ludov., 107. 1817. – *Rhus toxicodendron* var. *radicans* (L.) Torr., Fl. N. Middle United States, 1: 324. 1824.

*Toxicodendron radicans* is a deciduous woody trailing subshrub to shrub, or liana spreading by seeds and woody rhizomes, from 5 to 120 cm in height. When it grows as a liana, it can reach up to 15 m high. Leaves alternate, 6.5–40 cm long, consisting of 3 leaflets, middle leaflets with stalks 8–55 mm long, lateral leaflets with shorter stalks 0.5–6.0 mm long. Leaflet margins entire, toothed to rarely deeply lobed; leaves green during summer and colored various shades of yellow, orange, red or bronze in autumn; flowers clustered. Small, male and female flowers normally occur on separate plants. Fruits clustered, globose, green to yellow, waxy, 3–7 mm in diameter, one-seeded (Gillis, 1971; Mulligan & Junkins, 1977).

*Toxicodendron radicans* spreads vigorously by means of climbing stems that root along their entire length, as well as underground rhizomes that frequently produce new shoots (Senchina, 2008). In its native range, *Toxicodendron radicans* occurs in a wide variety of habitats, including forests, fields, riparian zones, seasonally or intermittently flooded areas, marshes,

swamps, cliffs, rocky ridges, and urban environments such as roadsides, gardens, and railway tracks. It also prefers human-disturbed habitats in its native range (Resler et al., 2022). As stated by some authors, *Toxicodendron radicans* thrives across a broad range of temperature conditions, as evidenced by its native North American distribution, which spans from Canada and the United States southward to Mexico (Gillis, 1971; Mulligan & Junkins, 1977).

## Study methods

During surveys of alien plant species in Lithuania's botanical gardens, a population of *Toxicodendron radicans* was found. One part of the population was in a grassland habitat. In contrast, the other one was in a woodland habitat (Fig. 1). Habitat types were identified (applying the third level) and named following the EUNIS Habitat Classification (Chytrý et al., 2020). The habitats were identified as V39 – Mesic perennial anthropogenic herbaceous vegetation (grassland) and V64 – Small deciduous broad-leaved planted or other wooded land (woodland), hereafter referred to as grassland and woodland, respectively. Therefore, 20 study plots (1 × 1 m) were distributed throughout the stands of *Toxicodendron radicans* in both habitat types to capture the full range of microhabitat variation. The coverage of each plant species across different layers (trees, shrubs, herbs, and mosses) was assessed separately, along with the

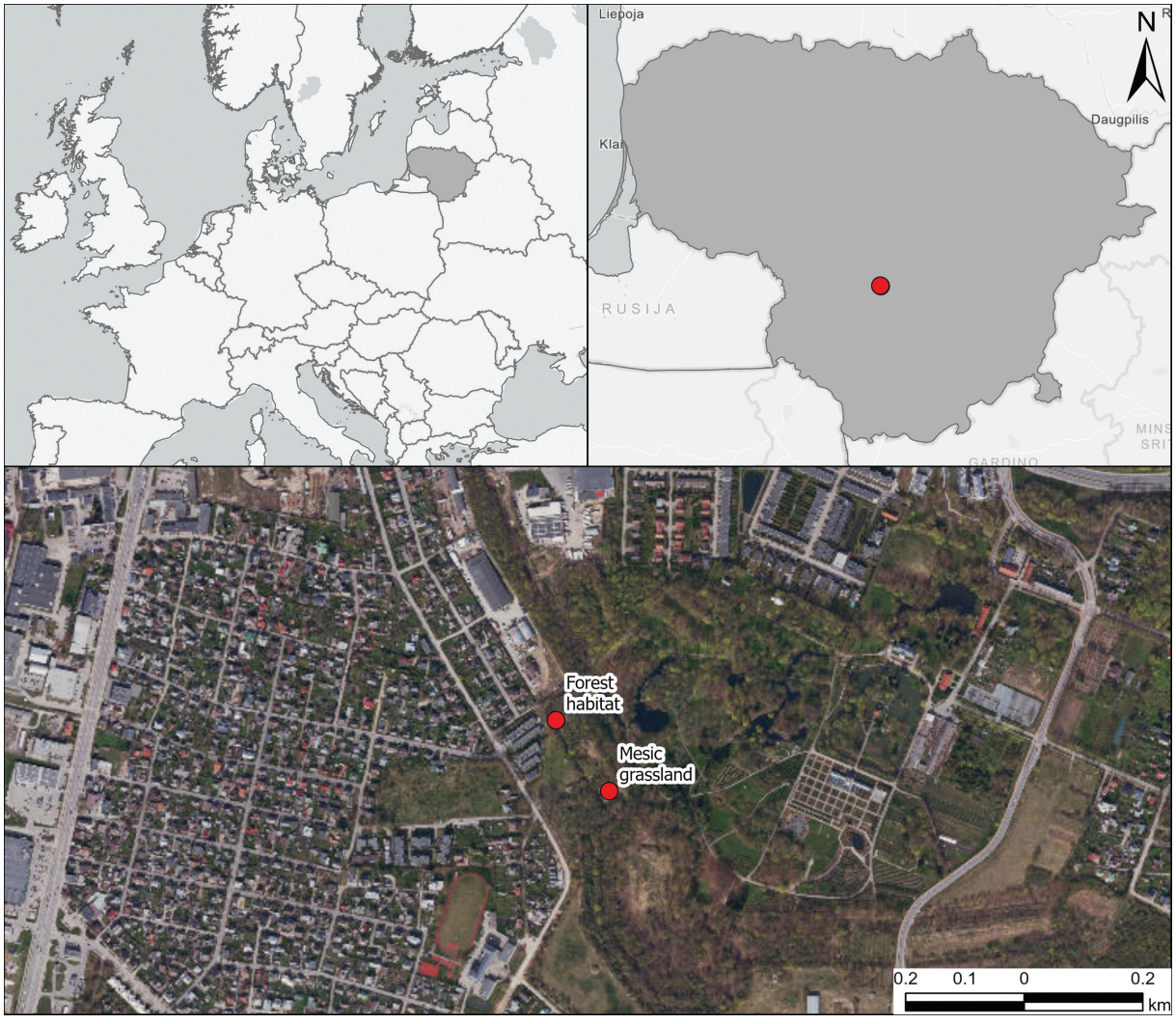


Fig. 1. Map with a locality of *Toxicodendron radicans* in Lithuania and study sites marked with red dots (54.86943° N, 23.90334° E and 54.87050° N, 23.90194° E).

total coverage of each layer. In total, 40 plots were used for the analysis (20 plots in grassland and 20 plots in woodland). To complement the fine-scale (1 m²) vegetation data, 100 m² plots were established in homogeneous sections of both habitat types. These were used to characterise the overall community composition and species dominance patterns at the stand level, enabling comparisons between both habitats. The herbarium specimen of *Toxicodendron radicans* collected by the authors is deposited at the Herbarium of the State Scientific Research Institute Nature Research Centre (BILAS) in Vilnius, Lithuania. The species names used follow the nomenclature of Plants of the World Online (POWO, 2025).

Normality of the collected data was assessed using the Shapiro-Wilk test. The number of species per plot, the number of herbaceous plants in grassland, the coverage of *Toxicodendron radicans* in woodland habitats, and total species number and total coverage met the assumption of normality, whereas the remaining variables did not. Consequently, non-parametric statistical methods were applied to account for deviations from normality. Pairwise comparisons of habitat characteristics (coverage and species number) were conducted using the Mann–Whitney post hoc test. The relationships between the cover of *Toxicodendron* and plant species diversity in the communities were assessed using Spearman's rank correlation ($r_s$). All calculations were performed using PAST 4.10 (Hammer et al., 2001).

## RESULTS

*Toxicodendron radicans* was first recorded in the central part of Lithuania (Fig. 2), behind the Kaunas Botanical Garden, in a mesic grassland habitat (23 July 2025, 54.86943° N, 23.90334° E, leg. L. Petrulaitis, BILAS 93399). On the same day, 150 m further, another patch of *Toxicodendron radicans* was found in woodland habitat (54.87050° N, 23.90194° E). The occupied area of both sites of *Toxicodendron radicans* is approximately 300 m². Mesic grassland habitat (Fig. 3a) was mainly comprised of *Dactylis glomerata* L., *Calamagrostis epigejos* (L.)


Fig. 2. *Toxicodendron radicans* in grassland habitat (A), *Toxicodendron radicans* in woodland habitat (B) on 23 July 2025. Photographs by L. Petrulaitis.

Table 1. Characteristics of studied communities of *Toxicodendron radicans* in Lithuania. Comparisons between habitat groups were performed using the Mann–Whitney test, and different letters indicate significant differences between the two samples

| | Grassland | Woodland | Total |
|---|---|---|---|
| Coverage of *T. radicans* (%) | 63.60 ± 30.35[a] | 35.75 ± 24.50[b] | 49.68 ± 30.67 |
| Coverage of woody plants (%) | 0.02 ± 0.03[a] | 9.68 ± 7.14[b] | 4.85 ± 6.99 |
| Coverage of herbaceous plants (%) | 22.17 ± 20.63[a] | 4.33 ± 6.17[b] | 15.24 ± 16.89 |
| Number of species | 5.90 ± 1.94[a] | 4.30 ± 1.41[b] | 5.10 ± 1.86 |
| Number of herbaceous plants | 5.75 ± 1.86[a] | 1.15 ± 0.93[b] | 3.45 ± 2.75 |

Roth, *Asclepias syriaca* L., *Festuca rubra* L. and accompanied by *Galium mollugo* L., *Galium boreale* L., *Lathyrus pratensis* L., *Carex hirta* L. and *Agrimonia eupatoria* L.

Woodland habitat was formed by *Populus tremula* L. and *Salix ×fragilis* L. in the tree layer. The shrub layer is dominated by *Crataegus monogyna* Jacq. and *Rhamnus cathartica* L., with a moderate abundance of *Cornus sanguinea* subsp. *australis* (C.A.Mey.) Jáv. and *Fraxinus excelsior* L. The herb layer is relatively sparse, dominated by a few species with low coverage values, including *Aegopodium podagraria* L., *Deschampsia cespitosa* (L.) P.Beauv., *Lysimachia nummularia* L. and *Carex sylvatica* Huds.

A total of 20 study plots were analysed for each habitat: grassland and woodland. In grasslands, *Toxicodendron radicans* exhibited higher mean coverage (63.60%) compared to woodland (35.75%), while other plant species showed greater coverage in grasslands (%) than in woodland (%) (Table 1). Additionally, the number of alien species was slightly higher in woodland habitats (6 species) than in grasslands (2 species). Species of alien origin included *Asclepias syriaca* L., *Heracleum sosnowskyi* Manden. in the grassland. In woodland, alien shrubs such as *Acer pseudoplatanus* L., *Cornus sanguinea* subsp. *australis* (C.A.Mey.) Jáv., *Lonicera caprifolium* L. and *Fagus sylvatica* L. were recorded.

In the woodland, a negative relationship was observed between *Toxicodendron radicans* coverage and plant species richness ($r_s = –0.62$; $p < 0.05$) (Fig. 3), showing the same trend as that found in the grassland habitat ($r_s = –0.62$; $p < 0.05$). An even stronger negative correlation was detected between *Toxicodendron radicans* coverage and the coverage of other plant species in grassland ($r_s = –0.86$; $p < 0.001$), while in the woodland this relationship was weak and not significant ($r_s = –0.22$; $p = 0.34$).

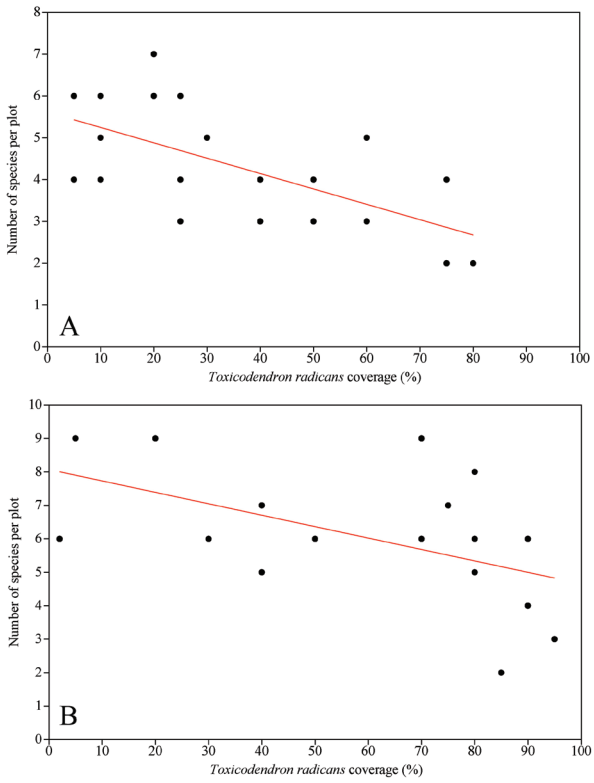


Fig. 3. Relationship between the coverage of *Toxicodendron radicans* and the number of plant species per plot in woodland habitat (A) and in grassland (B) habitat.

## DISCUSSION

*Toxicodendron radicans* was introduced into Europe around 1622 in France and 1640 in the United Kingdom (Pejchal & Štefl, 2019). In Lithuania, the introduction of *Toxicodendron radicans* is dated to 1814 (Skridaila, 1996). An additional historical record indicates that this species has been cultivated in the Kaunas Botanical Garden as a medicinal plant (Ribokaitė & Snarskis, 1960). According to Navasaitis (2008), this species is grown in Lithuania in dendrological collections, is flowering and

spreads by stolons (Navasaitis, 2008). In neighbouring Latvia, *Toxicodendron radicans* is known from eight sites (Laiviņš et al., 2009), although in the recent publication of alien woody species, only *Toxicodendron pubescens* Mill. is listed as a casual species (Evarte-Bundere et al., 2022). It is confirmed that in Europe, *Toxicodendron radicans* has been recorded in 11 countries: the Czech Republic (Vojík et al., 2022), France (Pax & Antoine, 2023), Germany (Griebl, 2020), Italy (Galasso et al., 2022), Lithuania, the Netherlands (Matthews et al., 2015), Slovakia (Medvecká et al., 2012), Slovenia (Martinčič, 1999), Poland (Janczyk-Węgłarska et al., 2014), and Ukraine (Koniakin et al., 2024). In Austria, the Vienna Botanical Garden took preventive action by removing *Toxicodendron radicans*, as this species is known to cause serious skin irritation upon contact (Kiehn, 2010). In Switzerland, the only confirmed sightings were in the Canton of Ticino, in private gardens, where cultivated plants had been removed (Schoenenberger et al., 2014; InfoFlora, 2022)

The results of our study indicate that *Toxicodendron radicans* exhibits stronger dominance and coexists with a richer herbaceous community in mesic grasslands. In contrast, forests support fewer herbaceous species but a greater abundance of woody plants, creating conditions more favourable for *Toxicodendron radicans*. Within its native range, *Toxicodendron radicans* occurs in both native and introduced plant communities. It is most common in thickets, along forest edges, and in glades (Mulligan & Junkins, 1977; Voss, 1985). The higher coverage of *Toxicodendron radicans* in grasslands than in woodland suggests that in late-successional forests, the species adopts a "sit-and-wait" strategy, maintaining low abundance in the tree canopy until disturbances such as tree fall create gaps in the vegetation (Matthews et al., 2015). Therefore, when these favourable conditions occur, *Toxicodendron radicans* can respond with rapid growth. Although *Toxicodendron radicans* is thought to prefer shady forests and thrive there in its native range, in its secondary range, it occurs in both shady and open habitats (Matthews et al., 2015). In north-east France, *Toxicodendron radicans* grows in a light forest, where it forms two types of growth: a shrub that reaches up to 2 meters and a liana that ascends trees to around 10 meters, with flowering and fruiting primarily in sunlit canopy openings (Pax & Antoine, 2023). The ability of *Toxicodendron radicans* to express multiple growth habits reflects complex interactions among abiotic and biotic factors operating at the landscape scale (Resler et al., 2022).

In its native range, at the northernmost limit of its distribution, *Toxicodendron radicans* occurs solely as a low-growing, trailing liana (Mulligan & Junkins, 1977). The same growth form is observed in the newly discovered population in Lithuania (Fig. 2), where plants remain under a meter tall and typically spread through trailing stems. Vegetative spread of this species in the native range is documented as quite low, 10 cm per year and frequently less than this. Spread by seed in Europe has been documented from Poland (Janczyk-Węgłarska et al., 2014). At a newly found site in Lithuania, no fruiting individuals were observed during visits.

*Toxicodendron radicans* is a relatively rare species throughout Europe. In several European countries, it is usually eradicated as soon as it is detected. The same approach should be applied if new sites are observed. It is also important to raise public awareness so that citizens can recognise and report this hazardous plant. In Lithuania, urgent measures should be conducted to eradicate the population to prevent further spread. The negative impact of *Toxicodendron radicans* on native plants should also be considered, as it possesses traits of invasiveness. Given the points above, botanists and ecologists must pay special attention to similar species to limit their continued expansion. It should be eradicated at the documented site of its spontaneous natural occurrence to mitigate safety hazards and prevent its subsequent spread.

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**Author contributions**. Conceptualisation, methodology, formal analysis, investigation, visualisation, writing, original draft preparation, review and editing, L.P. and T.P.; data curation, L.P.; supervision, L.P. Both authors have read and approved the final manuscript.

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