Invasiveness and Ecological Effects of Red Oak (*Quercus rubra* L.) in Lithuanian Forests

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Abstract

The introduction of alien tree species may cause a threat to biodiversity. Introduction should not be allowed if there are doubts concerning invasiveness of the introduced species. The plantations of red oak (*Quercus rubra* L.) in Lithuanian forests are established in 79 stands on an area of about 116 ha. However, its invasiveness has not been studied yet. The aim of the work is to ascertain the interaction between the red oak and native flora as well as to assess the expediency of growing red oak in Lithuanian forests. Red oak spreads more abundantly than common oak on less fertile sites. It has an adverse effect on the structure of local floral communities such as the number of grass species and their ocurrence degree decreases. Consequently, 11 nemoral grass species are not detected any more. The soil in the stands of red oak contains 34% less micromycetes, 20% less mineralizing and 5% less ammonifying microorganisms, than the soil in the stands of common oak. It contains lower amounts of the most trace elements important for the nutrition of plants than the soil in the stands of common oak. The intensity of red oak invasiveness is higher than the mean (0.65), possible distribution level is medium (0.57), the level of adverse effect on society is lower than the mean (0.35). We ascertained that introduction of red oak in Lithuanian forests is not advantageous from ecological viewpoint.

Key words: red oak (*Quercus rubra* L.), forest, invasiveness

Introduction

Some alien tree species used in forestry cause major problems as invaders of natural and seminatural ecosystems. The magnitude of the problem has increased significantly over the past few decades, with a rapid increase in afforestation and changes in land use (Richardson 1998). Alien plant species can make a major threat to biodiversity. Species that alter recruitment among native species can lead to changes in community composition (Myers 1983, Vitousek and Walker 1989) and in some cases, alter ecosystem functions such as fire frequency, nutrient cycling, and water availability (Vitousek *et al.* 1996). Invasive trees can affect all components of an environment, from ecosystem processes (Mack *et al.* 2001, Ehrenfeld 2003) to community structure (Garcia-Robledo and Murcia 2005, Gratton and Denno 2005) and biodiversity patterns (Brown and Gurevitch 2004). They can limit native plant growth or slow the rate of change in species composition (Lichstein *et al.* 2004). Rio Convention (1992) made biological diversity agreement to prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species. In Lithuania, these references are recommended to be followed: to prevent introduction of those species if alien species can become invasive; to allow introduction of the species if the benefit is significantly major than the damage; to prevent introduction if the negative ecological and economical influence of alien species is stated in other countries.

According to the data of standwise forest inventory (1993), in Lithuanian forests there are 14 alien tree species (5 broadleaved and 9 coniferous). Stands with prevailing introducents comprise an area of 3,564 ha (broadleaves – 349 ha, coniferous – 3,215 ha). Along with small groups and individual plants, 53 taxons of alien woody plants (Januškevičius *et. al.* 2006) were detected in Lithuanian forests.

Based on A.Svilans's methodics, about 40 invasive woody plant species were found in the forests of the southeastern part of Latvia. Red oak, estimated according to an original A.Svilans's methodics, was not ascribed to invasive plants.

Red oaks grow in 79 forest stands in Lithuania. The area of the stands is 116 ha. The stands are mostly in the central (37) and western (23) parts of Lithuania (Straigytė and Žalkauskas 2006).

Most trees are 50 and 20 (22 stands equal) years old. In 16 stands trees are 40-year-old. In the western part of Lithuania the old trees dominate, in the central part young red oak stands dominate, no more than 50-year-old.

Stands (65%) with red oaks mostly belong to medium fertility soil. The second big part of stands (20%) belongs to higher fertility soil, only some stands are in other soil types. The majority of stands are of typical medium-stocking level: 18 stands - 0.7 stocking level, 17 stands - 0.6 stocking level.

Stem damages, crown top condition and the stock of dry branches on trees were estimated in order to ascertain the health condition of red oaks.

The stems of the most trees (75%) are intact, 22% of tree stems are insignificantly damaged. The damage of tree stems (3%) comprises 26-60%. There are no trees with bigger stem damages in the stands. 56% of red oaks are without dry branches, on 41% of oaks mortality of branches comprises 30%, on 3% of oaks mortality of branches makes up 31-50%, but they are not considered as a part of crown dieback, because dead branches are below the upper 50% of the crown. The majority of trees (93%) are with the whole crown top. Oaks with damaged top are singly present.

In fertile soil the growth in height of red oak and common oak at the age of 120 years is similar (Gradeckas 2005). In less fertile soil red oak grows faster than common oak. It grows faster in diameter up to the age of 80, but later the increment becomes the same or lowers than that of common oak. At later stages, no marked difference in growth rate between these species was observed (Gradeckas 1990, 2005). Red oak has by 4 meters lower straight and free of branches trunk (on average 8 m) as compared to common oak (on average 12 m) (Straigytė and Žalkauskas 2006).

Some researchers concluded that wood yield of red oak stands is the highest on normally irrigated fertile and very fertile as well as on temporarily overmoist fertile site types (Gradeckas 2002). In comparison with common oak, the advantages of red oak were fast growth, ability to form dense stands (Danusevičius 2002). Dreimanis (2006), having studied growth characteristics of red oak stands to the age of 70 years in Latvian Škede district forest in *oxalidosa* site type, has found the following dendrometric characteristics of red oak: the average diameter – 30 cm; the average height – 25 m; average tree volume 0.83 m^3; average growing stock volume – 509 m^3/ha.

The invasiveness of red oak in Lithuania has not been studied up to now. There are no reliable data on its invasiveness in the neighbouring countries (Latvia, Belorus, Poland) as well.

The research aims are to determine the invasiveness and ecological effects of red oak in native Lithuanian forest. The following tasks were set:

1. To determine spreading peculiarities of red oak;
2. To determine the peculiarities of red oak interaction with dominant native plant species;
3. To determine influence on forest litter and soil of red oak;
4. To determine invasiveness degree of red oak.

Materials and methods

This study was conducted in 2005-2006 in 34 red oak forest stands, where the red oaks are of fruiting age. In the majority of stands red oaks are dominant, only in a few - second tree species.

Observation plots (2.5 x 10 m) within stands were located in the direction of stand diagonals. They comprise not less than 5% of the site area. Behind the stand boundary, 100 m^2 (R = 5.64) circular observation plots were located in N, E, S and W directions. The first one – behind stand boundary at the last red oak, others at 100, 200, 300 and 500 m distances from the boundary. Applying the methods of recognostic observation and questioning of forestry specialists, random propagules of red oak were looked for at a distance of 2 km from the studied stands.

On every stand all red oak seedlings taller than 30 cm were calculated. A headcount of damaged seedlings by deer was made.

Research of red oak stands were carried out at medium fertility and high fertility site types (accordingly *Oxalido-Quercetum* and *Hepatico-oxalido-quercetum* forest types according to S.Karazija fores type classification (Karazija 1988)).

Dispersion analysis of density correlation with growth conditions and spreading distance was conducted using the set of programs Statistica 6.0. The curve of density dependence on distance was drawn having applied exponential growth model.

All plant species in the red oak stands were recorded. The **circular (r = 5.64 m)** plots were selected in the stand dominated by red oak. Projection cover was estimated according to the Braun-Blanquet scale. A total of 30 geobotanical descriptions were made (Dierschke 1994). The nomenclature has been performed according to Rothmaler (1972, 1990). We selected **circular (r = 5.64 m)** plots for a comparative analysis of geobotanical descriptions conducted in natural *Quercus robur* forests. 14 descriptions were from *Tilio-Carpinetus stachytetosum* association and 12 – from *Tilio-Carpinetus typicum*. *Tilio-Carpinetus stachytetosum* communities form on nutrients rich fresh soil, *Tilio-Carpinetus typicum* communities – fresh soil on average rich in nutrients. The influence of red oak on native plants and their habitats has been ascertained comparing the abundance of plant species in first tree layer, second tree layer, shrub layer, herb layer and moss layer, coverage, occurrence in common oak stands. Indicator species for both stands has been determined using the Dufrene and Legendre method (1987) and PC-ORD set of programs. Indicator species are evaluated testing the statistical difference by using the Monte Carlo method. Comparative geobotanical analysis was carried out in 26 common oak stands. The differences of plant species coverage in red and common oak stands were evaluated using Canonical Correspondence Analysis (CCA) and Detrented Correspondence Analysis (DCA) (Jongman *et al.* 1997).

Leaf litter and soil were collected from pure stands of red oak and common oak. The litter was sterilized, dried and cut. Bottles were filled with 0.5 g litter from one of two species. Each soil core was mixed with 500 ml distilled water and filtered to create an inoculum. The bottles with inoculums and litter were incubated at 12°C. After 60 days, the litter removed, dried and litter mass loss was measured. The data were analyzed using linear models. Soil samples for chemical elements characteristics of each oak species were taken from A_1 soil horizon at 0-5 cm depth.

The Pest Plant Prioritisation Process (PPPP) is a prioritisation process or risk assessment, based on the AHP that ranks weeds by (Saaty 1995, Weiss *at al.* 2002):

1) assessing the plant's invasiveness; 2) comparing the plant's present and potential distribution; and 3) determining the impacts of the plant on social, economic, and environmental values.

The PPPP is therefore expressed as a hierarchy (Fig. 1), the components of which are weighted (using AHP) to allow the determination of a Pest Plant Assessment score for individual species.

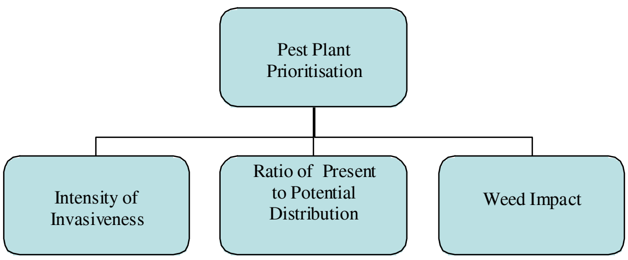

Figure 1. Hierarchy components of the Pest Plant Prioritisation Process (PPPP)

The scored intensity ratings for each criterion and their weightings are then calculated to produce a final invasiveness score (Weiss *et. al.* 2002):

Invasiveness score = Σ ((Group weighting x Criterion weighting) x Intensity rating)

Possible distribution was ascertained based on the material of standwise forest inventory, study data and on Panetta and Dodd (1987) intensity ratings scale (Table 1).

Table 1. The degrees of invasiveness to evaluate current versus potential distribution of the red oak

Degree	Weight	Regional Rating
Very High	1	Infestations with no chance of reinvasion from outside the area of the control.
High	0.85	Infestations with some chance of reinvasion
Medium High	0.71	Several small infestations beyond eradication
Medium	0.57	A large partially dispersed infestation or few widely scattered small infestations
Medium Low	0.42	Numerous large dispersed infestations or lots of scattered small infestations.
Low	0.28	The majority of region infested with some large areas still "clean" (more "clean" areas than infested)
Very Low	0.14	The majority of region infested with some smallish areas still "clean" (less "clean" areas than infested)
Extremely Low	0	Reached full potential – but may increase in density within infested area

The next stage of PPPP is to determine the social, environmental and economic impact of red oak. The influence of the plant was evaluated according to 24 criteria, rating them by intensity differences, (Weiss *et al.* 2002), based on the following formula:

Impact Score = Σ ((Criteria Group Weighting x Criteria weighting) x Criteria Intensity Rating)

The final stage of PPPP is to apply the results of invasiveness, distribution and impact assessments to determine the relative importance of weeds by calculating a Pest Plant Score. The formula for calculating the Pest Plant Score is:

Pest Plant Score = α (Invasiveness score) + β (Present:Potential Distribution) + γ (Impact);
where α, β, γ are weightings of the subcomponents (Weiss *et al.* 2002).

Results and discussion

Some important invasiveness indices of alien plants are the following: parameters of their natural distribution (density and spreading distance from parent trees), condition of plants (deer and other damages), peculiarities of their interaction with other plants (according to projection coverage and occurrence degrees of flora stories), influence on forest litter and soil peculiarities (activity of decomposing microorganisms and soil chemical properties).

Natural distribution

It was found that habitat influences the density of red oaks and their spreading distance from the patrent plant.. In red oak stands in soil of the medium fertility the average density of seedlings comprises 14.5 thous. trees/ha, while on soil of high fertility only 6 thous. trees/ha (Figure 2). In soil of the high fertility the density of seedlings is always lower.

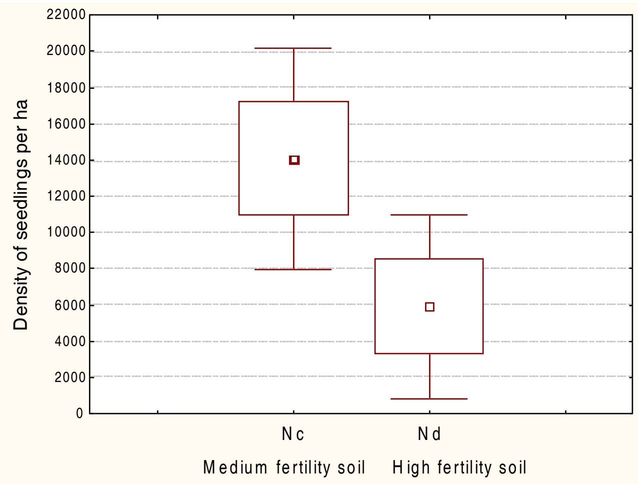

Figure 2. The influence of seedling density on soil fertility in the red oak stands

The best distribution of red oak is recorded in medium fertile soil (Figure 3).

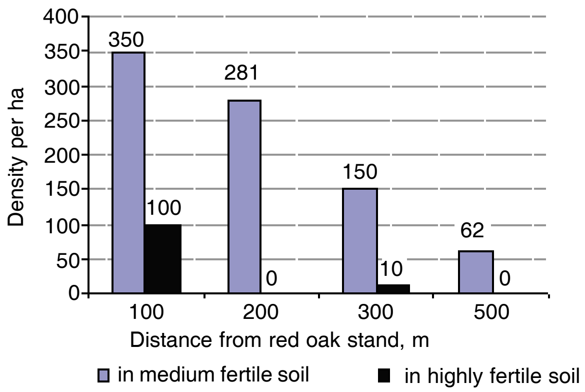

Figure 3. The relationship between seedling density and distance from red oak stand

In highly fertile soil seedlings spread only within the boundaries of the stand and 10 m further. In medium fertile soil red oak seedlings are found 500 m (sometimes 1.5 km) away from the cropper red oak. It can be explained by the fact that jay (*Garrulus Glandarius*) disperses oak acorns more in the litter of dryer and less fertile soils (Riepšas *et al.* 2002).

No reliable dependance of the red oak seedlings on the crown closure of parent stand was found in the studied habitats (Figure 4).

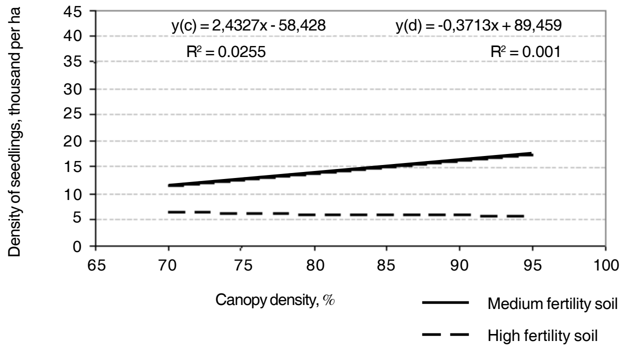

Figure 4. Influence of red oak seedling density on crown closure of the parent stand in soils of different fertility

Condition of seedlings

Deer (*Cervidae*) markedly affect the condition of red oak seedlings. Seedlings damaged by deer were counted on the second-year growth and older seedlings. Animals have been browsed 95% of all seedlings. A few year-old seedlings were browsed repeatedly, twice or even more. Only 5% of seedlings are intact. Browsed saplings distinguished by a slanted leading shoot (Table 2).

Table 2. Deer browsing upon seedlings

	Sound seedlinds	Damaged seedlings	Total
Seedlings	4	81	85
Percentage	5%	95%	100%

Gradeckas (2005) has conducted study of damage caused by deer to red oak plantation determining 92% of damaged saplings. Some foresters suppose that deer do not prefer red oak saplings while the obtained results deny this opinion.

Interaction of red oak with other plants

The aim of this work was to determine the differences of vegetation structure and species composition in alien red oak and native common oak stands.

Detrented Correspondence Analysis showed that natural common oak forest formed compact conglomeration in the ordination space. Red oak stands were separated in ordination space. It means that species composition of common oak and red oak communities differed.

Canonical Correspondence Analysis of both species in of the oak stands with vegetation structure indices (species number, cover of tree, shrub, herb and moss layers) showed that species quantity, cover of second tree layer, cover of herb layer were higher in natural common oak forests (Figure 5). Cover of shrub layer was slightly higher in the red oak stands.

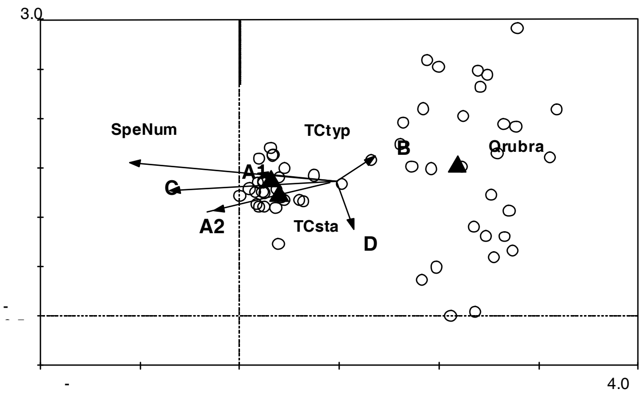

Figure 5. Canonical Correspondence Analysis on *Q.rubra*, *Q.robur* of *Tilio-Carpinetum stachyetosum* (TCsta) and *Tilio-Carpinetum typicum* (TCtyp) plots. (Stand structure indices (species number (SpeNum), cover of first tree layer (A1), second tree layer (A2), shrub layer (B), herb layer (C), moss layer (D)).

Species number was significantly lower in the red oak stands. The majority of typical nemoral euthrophic species disappeared from the red oak stands.

Influence on forest litter and soil

After analyzing biological activity of decomposing microorganisms and the amount of micro and macro elements important for plant nutrition in the soil, there was assessed the influence of red oak on forest litter and soil.

The litter was incubated from two oak species (*Q.rubra, Q.robur*) in the presence of biota extracted from the soil beneath the stand of each species to test the hypothesis that litter decomposes faster in the presence of biota derived from the soil, where that species is locally abundant (Hunt *et al.* 1988, Gholz *et al.* 2000).

Our and other (Klironomos 2002) studies show that invading species are generally free of the biotic interactions that occur in their natural range. This provides them with a competitive advantage over native species that have many co-evolved predators present. Besides, the results of our studies that the abundance of species in a stand induces the activity of decomposing microorganisms, comply with the results of other authors (Ayres *et al.* 2006).

Mass loss from the red oak litter was greater than from the common oak litter (Figure 6).

There is linear dependence between the increase in CO_2 quantity and loss of litter mass in the process of litter decomposition of both oaks (Figure 7).

Later, the abundance of microorganisms in red oak and common oak soils was defined (Fig. 8). There were more microbes in the common oak soil than in the red oak soil (Fact - 12.19 ammonium fixing microorganisms,

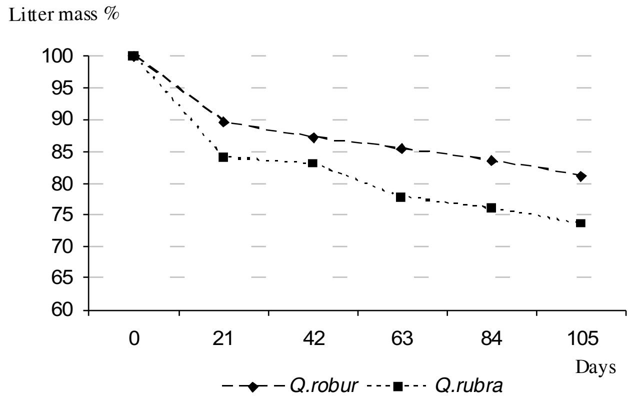

Figure 6. Litter mass loss of common oak and red oak species

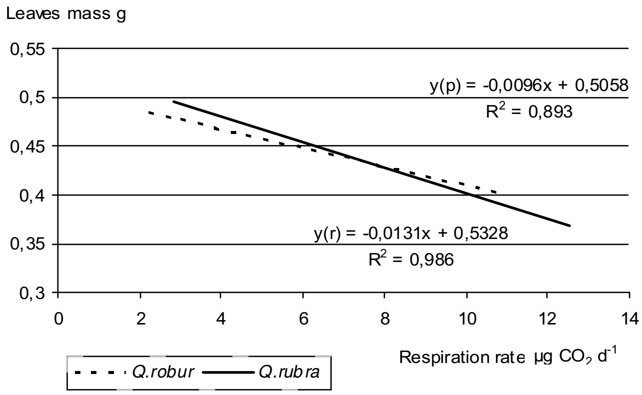

Figure 7. The linear dependence between the increase of CO_2 and loss of litter mass

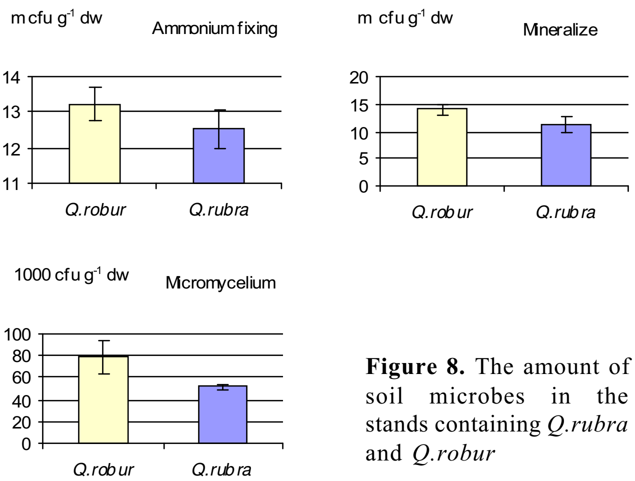

Figure 8. The amount of soil microbes in the stands containing *Q.rubra* and *Q.robur*

14.95 mineralised microorganisms and 24.73 micromycetes).

It was expected that lower amount of microbes in the red oak soil determines lower litter decomposition. But results of this research show the opposite: more intensive is decomposition of the red oak litter. It is because of positive feedbacks between invasive red oak and soil nutrient cycles.

Positive feedback of invasive plants on soil biocoenosis was observed by other scientists as well (Bever *et al.* 1997, Klironomos 2002). However, the opinion prevails that the litter of invasive trees enriches less the soil with micro and macro elements important for plant nutrition. Only a few researchers think that a more exhaustive answer to the question requires more extensive studies (Myers 2005).

We have ascertained that Calcium and Manganese in the red oak and common oak soils are comparable. Potassium is by 60% more abundant in red oak soil than in common oak soil, but it contains 40% less phosphorus. Soil microelement analysis shows that all these elements are more significant in the common oak soil (Table 3).

Table 3. Chemical composition of the soil cropped with *Q.rubra* and *Q.robur*

Chemical elements	*Q.rubra*	*Q.robur*	*Q.rubra* % : *Q.robur*
N mg/l:	11	11	0
P mg/l	9,0	15	-40
K mg/l	120	75	+60
Ca mg/l	49	53	-8
Mg mg/l	13	14	-7
Fe mg/l	675	2050	-67
B mg/l	1,16	1,43	-19
Mn mg/l	106	272	-61
Cu mg/l	3,6	6,5	-45
Zn mg/l	5,9	15	-61

Laboratory analysis showed that the amounts of all macro elements in the red oak leaves are lower (except Ca) than in the native oak leaves. However, these differences are very insignificant.

Invasiveness of red oak

Invasiveness can be defined as the ability to establish, reproduce, and disperse within an ecosystem. Plant propagules arrive at a new site with certain inherent characteristics that previously enabled their successful survival and continued reproduction throughout their evolutionary history (Table 4).

Current and potential distributions are another major components required in the decision support system and AHP to predict the status of a weed. The greater the potential distribution of a weed, the greater the potential impact and management costs. Intensity ratings for evaluating the ratio of present to potential distribution are shown in Table 1. Having evaluated the present versus potential distribution of red oak, we established medium intensity rating (weight 0.57).

Table 4. Group and criteria weightings for determining invasive degree

Group	Criteria	Rating	Invasiveness
Establishment			
	Germination requirements?	0.75	0.0319
	Establishment requirements?	0.50	0.1678
	Disturbance requirements?	0.5	0.061
Growth/competitive ability			
	Life form?	0	0
	Allelopathic properties?	0.75	0.0065
	Tolerates herbivory pressure?	0.5	0.0228
	Normal growth rate?	1	0.0184
	Stress tolerances?	0.75	0.0133
Reproduction			
	Reproductive system?	0.5	0.0028
	Propagule production?	0.5	0.0274
	Seed longevity?	0	0
	Reproductive period?	1	0.012
	Time to reproductive maturity?	0	0
Dispersal			
	Number of mechanisms?	1	0.0946
	How far do propagules disperse?	1.00	0.1894
		Total:	**0.6478**

Many weeds are recorded as occurring along roadsides. Some riparian weeds may occur along small rivers, streams and water channels. This is a major limitation when predicting potential distribution. But propagules of the red oak are spread near red oak plantations. It is easier to predict the direction and distance of their spread.

The next stage of the PPPP, before calculating a Pest Plant Score, is to determine the social, environmental, and economic impacts of pest plants. Criteria for rating the red oak impact are shown in Table 6. We found that the Impact score is very low (0.16).

The final stage of the PPPP is to apply the results of invasiveness (Table 4), distribution (Table 1), and impact assessments (Table 5) to determine the relative importance of weeds by calculating a Pest Plant Score. Experts determined a preliminary ranking of the three subcomponents of the PPPP (Weiss and McLaren, 2002). The study suggests that invasiveness was considered less important than distribution, which in turn was considered less important than impact, with the following ratios:

Invasiveness is 3 times less important than distribution;

Invasiveness is 4 times less important than impact;

Distribution is half as important as impact.

The Pest Plant Assessment score is expressed as:

Table 5. Group and criteria ratings for determining impact

Criteria	Rating	Impact
SOCIAL (Tourism, Visual aesthetics, Experience, Cultural sites)		
1. To what extent does the weed restrict human access?	0	0
2. At what level does this weed reduce the 'tourism / aesthetics/ recreational use of the land?	0	0
3. At what level is the plant injurious, toxic, or spines affect people?	0	0
4. How much damage is done to indigenous or european cultural sites?	0.5	0.006
NATURAL RESOURCES – SOIL, WATER & PROCESSES		
5. To what extent does this weed impact on water flow within watercourses or waterbodies?	0	0
6. To what extent does the weed impact on water quality (ie. Dissolved 02, water temperature)?	0	0
7. To what extent does the weed increase soil erosion?	0	0
8. To what extent does this weed reduce the biomass of the community? (nb. Biomass acting as a carbon sink).	0.25	0.0012
9. To what extent does the weed change the frequency or intensity of fires?	0	0
Fauna and flora / vegetation & EVCs		
10. To what extent does this weed impact on the vegetation composition on the following:		
a. High value EVCs	0.5	0.04
b. Medium value EVCs	0.5	0.025
c. Low value EVCs	0.25	0.0037
11. To what extent does this weed effect the structure of a vegetation community?	0.5	0.0345
12. What effect does the weed have on threatened flora spp.?	0.25	0.015
Flora & fauna/fauna		
13. What effect does the weed have on threatened fauna spp.?	0	0.
14. What effect does the weed have on nonthreatened fauna spp.?	0.25	0.007
15. To what extent does this weed provide benefits or facilitates the establishment of indigenous fauna?	0.75	0.017
16. To what extent is the plant toxic, its burrs or spines affect indigenous fauna?	0.5	0.008
FLORA AND FAUNA/ FAUNA /Pest Animal		
17. To what extent does this weed provide a food source to assist in success of pest animals?	0	0
18. To what extent does this weed provide habitat / harbor for serious pests?	0	0
AGRICULTURE – Quality, Quantity, Cost to Production, Effect on land use and value		
19. To what extent does this weed impact on the quantity or yield of agricultural produce?	0	0
20. To what extent does the weed impact on agricultural quality?	0.25	0.008
21. To what extent does this weed affect land value?	0	0
22. To what extent does this weed cause a change in priority of land use?	0	0
23. To what extent the presence of the weed increases the cost of harvest?	0	0
24. To what extent does this weed act as an alternative host or vector for diseases of agriculture?	0	0
		0.16

Pest Plant Score = α (Invasiveness score) + β (Present:Potential Distribution) + γ (Impact), where α, β and γ are weightings of the subcomponents (Figure 9).

The formula for calculating the Pest Plant Score is:

Pest Plant Score = α (0.65) + β (0.57) + γ (0.16) = 0.12 (0.65) + 0.32 (0.57) + 0.56 (0.16) = 0.36.

Red oak has relatively low Pest Plant Score of 0.36.

The obtained invasiveness index shows that red oak according to the main parameters of invasiveness is not high, it is lower than the average. This index is highly dependant on rating priorities. In our case intensity index was the highest and if a coefficient į had been rated higher by experts, the final level of invasiveness would have been even higher.

E.g: if α = 0.56, β = 0,12, γ = 0,32, the level of invasiveness would be:

I = 0,56 x 0,6478 + 0.12 x 0,57 + 0,32 x 0,16 = 0,32 + 0,068 + 0,05 = 0,44

Rating may differ depending on the category of forest, status of protected territories, historical places, *etc*. If invasive plants grow nearby protected territories, they cause other threats than those growing in economic forests. In national parks alien plants are generally unwellcome. Rating priorities should be ascertained for the specific regions taking into account the functions prevailing in these territories.

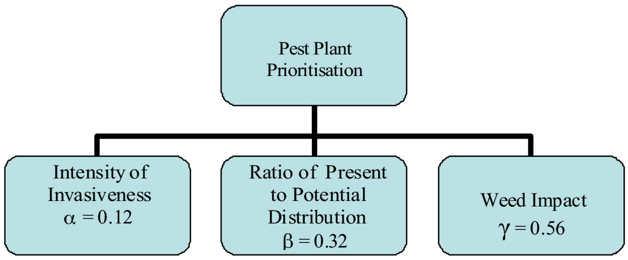

Figure 9. Hierarchy components of the Pest Plant Prioritisation Process (PPPP) (Weiss and McLaren 2002)

Conclusions

1. In high fertility site types propagules are dispersed within not big radius. In site types of medium fertility groups of propagules are spread 0.5 km radius. Individual seedlings spread within 1.5 km radius.

2. Vegetation structure of alien red oak stands and natural common oak forests is different. The cover of the second tree layer and herb layer was lower in the red oak stand. The cover of the shrub layer was slightly higher in the red oak stands. Species number was significantly lower in the red oak stands. The majority of characteristic nemoral euthrophic species was lacking in red oak stands.

3. Red oak negatively influences the amount of soil microbes that specialize in litter decomposition. There are less microelements in the red oak soil (Fe-67%, B-19%, Mn-61%, Cu-45%, Zn-61%) than in common oak soil.

4. As red oak oversteps naturalization barrier and is at invasive stage, it is unwelcome in the forest. Invasiveness range is medium high (0.65), current and potential distribution ratings are medium (0.57); social, environmental, and economic impact ratings are very

low (0.16). The final Pest Plant Score rating is medium low (0.35).

5. Growing of red oak in Lithuanian forest is not advantageous ecologically. Because of its ornamental and fast growth it can be cultivated in urban territories.

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ИНВАЗИВНОСТЬ И ЭКОЛОГИЧЕСКИЙ ЕФФЕКТ КРАСНОГО ДУБА (*QUERCUS RUBRA* L.) В ЛЕСАХ ЛИТВЫ

Э. Репшас и Л. Страйгите

Резюме

Разведение интродуцентов лесных древесных пород в лесах может существенно повлиять на биологическое разнообразие местных экосистем. При наличии информации об инвазивности интродуцента разведение в лесах необходимо контролировать. Насаждения красного дуба (*Quercus rubra* L.) в лесах Литвы имеются на 79 участках на общей площади 116 га. Инвазивность этого интродуцента до сих пор не была изучена.

Цель этой работы – оценить особенности соотношения красного дуба с местной лесной флорой и определить целесообразность разведения в лесах Литвы.

Установлено, что красный дуб распространяется по площади интенсивнее дуба обыкновенного в менее богатых лесорастительных условиях. Он оказывает отрицательное влияние структуре и разнообразию местной флоры: уменьшается количество видов травянистой растительности, необнаружено 11 видов неморальных трав. В почве древостоя красного дуба на 34% меньше микромицетов, на 20% - барнерий минерализирующих и на 5% - бактерий амонифицирующих органические вещества, чем в почвах древостоев дуба обыкновенного. Меньше обнаружено и важнейших микроэлементов минеральной пищи растений.

Уровень интенсивности инвазии выше среднего (0,65), уровень возможного распространения – средний (0,57), уровень отрицательного влияния обществу - ниже среднего (0,35).

Установлено, что разведение красного дуба в лесах Литвы нецелесообразно как в экологическом, так и в экономическом отношениях.

Ключевые слова: дуб красный (*Quercus rubra* L.), лес, инвазивность