

Notes on invasive and expansive trees and shrubs

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ABSTRACT: Expansion and invasion of plants indicate successful colonization and competitive abilities of species. There are fewer invasive and expansive woody plants than herbs. Main expansive (native species) trees and shrubs are *Acer platanoides*, *Acer pseudoplatanus*, *Clematis vitalba*, *Crataegus* sp. div., *Fraxinus excelsior*, *Prunus spinosa*, *Rubus* sp. div., *Sambucus nigra*. Main invasive (alien species) are *Acer negundo*, *Ailanthus altissima*, *Amorpha fruticosa*, *Cytisus scoparius*, *Fraxinus pennsylvanica*, *Lycium barbarum*, *Mahonia aquifolium*, *Physocarpus opulifolius*, *Pinus strobus*, *Populus × canadensis*, *Prunus serotina*, *Quercus rubra*, *Rhus typhina*, *Robinia pseudoacacia*, *Symphoricarpos albus*, *Syringa vulgaris*. Dominant characteristics of expansive and invasive species are dispersibility of seeds and capacity of vegetative propagation.

Keywords: expansive trees and shrubs; invasive trees and shrubs

The problems of plants expanding in a new area and even into original plant communities at the present time become increasingly importance. Native plants spreading in the landscape after changes in land management are described as expansive, introduced plants with self-reproduction in areas distant from the sites of introduction as invasive. A great part of articles describes invasion or expansion of herbs and grasses. Woody plants successful in succession and growing over the void soil have other characteristics than species entering into plant communities with steady competition relations. It is necessary to find methods for research on success of woody plants on the void soil or in the plant communities.

At succession of woody plants it is difficult to discover common rules for plant characters and stand factors. It is difficult for woody plants to establish themselves at extreme sites, on the contrary, at damp and rich sites herbs and grasses can be main competitors during succession. At succession *Betula pendula*, *Pinus sylvestris*, *Sambucus nigra*, *Crataegus* spec. div., *Prunus spinosa* are usually successful. At succession there also appear *Acer campestre*, *Acer pseudoplatanus*, *Alnus glutinosa*, *Frangula alnus*,

Fraxinus excelsior, *Populus tremula*, *Rosa* spec. div., *Rubus caesius*, *Rubus fruticosus* agg., *Rubus idaeus*, *Salix aurita*, *Salix caprea*, *Salix cinerea*, *Salix fragilis*, *Sorbus aucuparia*, *Swida sanguinea*.

Only some species of invasive and expansive woody plants are successful at succession. Among the native woody plants these are expansive species *Fraxinus excelsior*, *Acer platanoides*, *Acer pseudoplatanus*, *Clematis vitalba*, *Crataegus* sp. div., *Prunus spinosa*, *Rubus* sp. div., *Sambucus nigra*.

Invasive are *Acer negundo*, *Ailanthus altissima*, *Amorpha fruticosa*, *Cytisus scoparius*, *Fraxinus pennsylvanica*, *Lycium barbarum*, *Mahonia aquifolium*, *Parthenocissus inserta*, *Physocarpus opulifolius*, *Pinus strobus*, *Populus × canadensis*, *Prunus serotina*, *Quercus rubra*, *Rhus typhina*, *Robinia pseudoacacia*, *Symphoricarpos albus*, *Syringa vulgaris*.

Success of woody plants at invasion and expansion (PRACH, PYŠEK 1998, 2003) is connected with these characteristics: way of pollination, fertility, dispersibility of seeds, capacity of vegetative propagation, ability to germinate several years and in a wide range of conditions, capacity to regenerate, high competitiveness inclusive growth rate and early start of fertility (Table 1).

Table 1. Propagation of invasive and expansive trees and shrubs

| Taxon | Propagation by seeds | Vegetative propagation |
|------------------------------------|----------------------|------------------------|
| <i>Acer negundo</i> | Yes | No |
| <i>Acer platanoides</i> | Yes | No |
| <i>Acer pseudoplatanus</i> | Yes | No |
| <i>Ailanthus altissima</i> | Yes | Yes |
| <i>Amorpha fruticosa</i> | Yes | Yes |
| <i>Clematis vitalba</i> | Yes | No |
| <i>Crataegus</i> sp. div. | Yes | No |
| <i>Cytisus scoparius</i> | Yes | No |
| <i>Fraxinus excelsior</i> | Yes | No |
| <i>Fraxinus pennsylvanica</i> | Yes | No |
| <i>Lycium barbarum</i> | Yes | Yes |
| <i>Mahonia aquifolium</i> | Yes | Yes |
| <i>Physocarpus opulifolius</i> | Yes | No |
| <i>Pinus strobus</i> | Yes | No |
| <i>Populus</i> × <i>canadensis</i> | Yes | Yes |
| <i>Prunus serotina</i> | Yes | No |
| <i>Prunus spinosa</i> | Yes | Yes |
| <i>Quercus rubra</i> | Yes | No |
| <i>Rhus hirta</i> | Yes | Yes |
| <i>Robinia pseudacacia</i> | Yes | Yes |
| <i>Rubus</i> sp. div. | Yes | Yes |
| <i>Sambucus nigra</i> | Yes | No |
| <i>Symphoricarpos albus</i> | Yes | Yes |
| <i>Syringa vulgaris</i> | Yes | Yes |

All woody plants which behave themselves as invasive were introduced into our territory for esthetical purposes (*Acer negundo*, *Ailanthus altissima*, *Amorpha fruticosa*, *Fraxinus pennsylvanica*, *Lycium barbarum*, *Mahonia aquifolium*, *Physocarpus opulifolius*, *Prunus serotina*, *Rhus typhina*, *Symphoricarpos albus*, *Syringa vulgaris*), for soil enrichment with nitrogen (*Cytisus scoparius*, *Amorpha fruticosa*, *Robinia pseudoacacia*) or as wood-yielding species (*Pinus strobus*, *Populus* × *canadensis*, *Quercus rubra*, *Robinia pseudoacacia*).

MATERIAL AND METHODS

List of invasive trees and shrubs in our territory is based on alien plants catalogue of the Czech Republic (PYŠEK et al. 2002). This list is completed with the

expansive woody plants (HEJNÝ, SLAVÍK 1988, 1990, 1992; SLAVÍK 1995, 1997). It also includes important characteristics of woody plants connected with successful invasion or expansion (BÄRTELS 1988; EISELT, SCHRÖDER 1977; HIEKE 1978; WALTER 1978).

RESULTS

Characteristics of invasive plants

Aceraceae:

Acer negundo: wind pollination; fruit – achene with wings; germinating power of seeds decreases soon; fast-growing seedlings, suffer from spring frosts; fast-growing trees, first fruits in 10 years; short life; light-demanding, wildings in floodplain forests or at anthropogenic sites.

Amygdalaceae:

Prunus serotina (*Padus serotina*): insect pollination; fruit – drupe; seed spreading by birds.

Anacardiaceae:

Rhus typhina: fruit – drupe; root suckers; light-demanding.

Berberidaceae

Mahonia aquifolium: insect pollination; fruit – drupe; good germination ability for 4 years; seed spreading by birds; root suckers; low demands on soil, warm areas.

Caprifoliaceae:

Symphoricarpos albus (*S. racemosus*, *S. rivularis*): insect pollination; fruit – berry; good germination ability; root suckers; low demands on soil, wildings in river valleys.

Fabaceae:

Amorpha fruticosa: insect pollination; fruit – pod; good germination ability for 2–3 years; root suckers; dry poor soils, light-demanding.

Cytisus scoparius (*Sarothamnus scoparius*): insect pollination; fruit – pod; seeds with germination power 50–70% for 25 years; suffers from frost, regenerates; light sandy soils, dry places, frontier plant on dump, wood margins; planted since the 18th and 19th century.

Robinia pseudacacia: insect pollination; fruit – pod; hard seeds, germination ability 50% for 6 years; seedlings sensitive to frost; it produces fruits for the first time at the age of 20–30 years; root suckers.

Fagaceae:

Quercus rubra: wind pollination; fruit – achene; germination ability by spring, it quickly loses seed viability, seeds damaged by fungi and rodents; it produces fruits for the first time at the age of 25–30 years; low demands on soil, it badly tolerates stagnant waters and too dry soils.

Oleaceae:

Fraxinus pennsylvanica: wind pollination; fruit – achene with wings; germination ability 60–70% for 1–2 years; it produces fruits for the first time at the age of 20 years, canopy closure at the age of 40 years; it quickly spreads first of all in secondary stands, endures polluted environment.

Syringa vulgaris: insect pollination; fruit – capsule; seeds with wing; at the injury of roots it produces tillers; root suckers; frost-hardy, resistant to drought and pollution, not suitable for wet and acid soils, likes sunny places.

Pinaceae:

Pinus strobus: wind pollination; seeds with wings; capable of germinating for 3–5 years; fast growth, it produces fruits for the first time at age 40–50 years; fungal pathogen *Cronartium ribicola*.

Salicaceae:

Populus × canadensis (*P. deltoides × nigra*, *P. × euroamericana*): wind pollination; fruit – capsule; light, downy seeds; with extremely short germination ability, only for several days, seeds germinate 18 hours after sowing, germination ability 80%; it produces seeds for the first time in 15–20 years; rapid growth in rich damp soils, sunny, warm sites, it suffers from fungal diseases in dense overgrowth.

Simaroubaceae:

Ailanthus altissima (*A. glandulosa*): wind pollination; fruit – achene with wing; seeds able to germinate 60% for 1 year; frost-killed seedlings; it produces seeds for the first time at the age of 10–15 years; at the injury of roots it produces tillers; warm areas (Polabí, Southern Moravia), resistant to pollution, above all in urban environment.

Solanaceae:

Lycium barbarum (*L. halimifolium*): insect pollination; fruit – berry; germination ability 50%, seeds germinate quickly; root suckers; secondary stands, resistant to pollution, sunny sites, rich soils.

Spiraeaceae:

Physocarpus opulifolius: insect pollination; fruit – follicle; numerous small seeds; low demands on soil, in riparian shrubbery, in forests near towns, frost-hardy.

Characteristics of expansive plants

Aceraceae:

Acer platanoides: fruit – achene with wing; germination ability 50–60% quickly lost; frost-killed seedlings; it produces seeds for the first time at the age of 20–25 years; sunny places, synanthropic stands.

Acer pseudoplatanus: fruit – achene with wing; germination ability 80–90% quickly lost; frost-killed seedlings; it produces seeds for the first time at the age of 30–35 years; sunny places, synanthropic stands.

Amygdalaceae:

Prunus spinosa: fruit – drupe; germination ability 60–80% for 2 years; root suckers; shrubby sun-exposed hillsides, secondary stands.

Malaceae:

Crataegus sp. div.: fruit – pome; seeds disseminated by birds; germination ability 3 years.

Oleaceae:

Fraxinus excelsior: fruit – achene with wing; germination ability 60–70% for 1–2 years; it produces seeds for the first time at the age of 20 years, in the forest 40 years.

Ranunculaceae:

Clematis vitalba: fruit – achene; wind-borne; germination ability 2 years; fast growth.

Rosaceae:

Rubus sp. div.: fruit – drupe; high germination ability; root suckers.

Sambucaceae:

Sambucus nigra: fruit – drupe; disseminated by birds; forest edges, clearings, soils with nitrogen and humus.

CONCLUSIONS

A majority of expansive and invasive woody plants is disseminated by wind or by birds. Out of the 24 evaluated species 11 woody plants are spread by wind such as *Acer*, *Ailanthus*, *Fraxinus*, *Pinus*, *Populus* while 7 woody plants such as *Mahonia*, *Prunus*, *Crataegus*, *Sambucus* are disseminated by birds. Only some woody plants have no ability for long-distance dissemination, for example *Quercus* and *Cytisus*.

Vegetative propagation of plants makes it possible to remain at the site and to expand slowly in the surroundings (11 species).

Successful propagation is frequent in suburban conditions although there are not any optimum conditions for these plants. Invasive and expansive trees and shrubs are able to adapt themselves to extreme conditions. They are frequently in warmer regions and at open sites.

Pinus strobus also spreads in forests probably due to the low activity of the fungal pathogen *Cronartium ribicola*.

There is a danger of dissemination of invasive and expansive woody species in suburban forests, forests in warm regions and near major rivers, forests on anthropogenic substrates. Woody species also appear in xerothermic plant communities.

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Poznámky o invazních a expanzních dřevinách

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ABSTRAKT: Expanzní nebo invazní chování rostlin indikuje jejich schopnost úspěšně kolonizovat nová území a schopnost kompetice. Mezi dřevinami je méně expanzních a invazních rostlin než mezi bylinami. Hlavní expanzní (naše původní) dřeviny jsou *Acer platanoides*, *Acer pseudoplatanus*, *Clematis vitalba*, *Crataegus* sp. div., *Fraxinus excelsior*, *Prunus spinosa*, *Rubus* sp. div., *Sambucus nigra*. Hlavní invazní (pocházející z jiných zemí) dřeviny jsou *Acer negundo*, *Ailanthus altissima*, *Amorpha fruticosa*, *Cytisus scoparius*, *Fraxinus pennsylvanica*, *Lycium barbarum*, *Mahonia aquifolium*, *Physocarpus*

opulifolius, *Pinus strobus*, *Populus × canadensis*, *Prunus serotina*, *Quercus rubra*, *Rhus typhina*, *Robinia pseudoacacia*, *Symphoricarpos albus*, *Syringa vulgaris*. Důležitými charakteristikami expanzních a invazních rostlin jsou šířitelnost semen a schopnost vegetativně se šířit.

Klíčová slova: expanzní dřeviny; invazní dřeviny

Naše původní dřeviny, které se za určitých podmínek mohou chovat expanzivně, se šíří obvykle na větší vzdálenosti semeny pomocí větru (*Acer platanoides*, *A. pseudoplatanus*, *Clematis vitalba*, *Fraxinus excelsior*) nebo jsou rozšiřovány ptactvem (*Crataegus* sp. div., *Prunus spinosa*, *Rubus* sp. div., *Sambucus nigra*). Pouze některé (*Prunus spinosa* a *Rubus* sp. div.) se intenzivně šíří i pomocí vegetativního rozrůstání.

Ze všech 24 uvedených taxonů (původních i cizokrajných), které se na našem území mohou chovat jako expanzní nebo invazní, se šíří pomocí větru 11 taxonů (*Acer*, *Ailanthus*, *Fraxinus*, *Pinus*, *Populus*). Rozšiřování pomocí ptactva známe u sedmi dřevin, např. *Mahonia*, *Prunus*, *Crataegus*, *Sambucus*. Méně běžné je šíření semen na větší vzdálenosti u *Quercus* a *Cytisus*.

Vegetativní rozšiřování je obvykle pomalé a objevuje se častěji u nepůvodních dřevin, jako je *Ailanthus altissima*, *Lycium barbarum*, *Mahonia aquifolium*, *Rhus hirta*, *Robinia pseudoacacia*, *Symphoricarpos albus*.

Dřeviny se úspěšně šíří především v prostředí ovlivněném člověkem, v okolí měst a na antropogenních substrátech (*Acer negundo*, *A. platanoides*, *A. pseudoplatanus*, *Lycium barbarum*, *Physocarpus opulifolius*, *Sambucus nigra*), především na volné plochy bez zapojeného vegetačního porostu. Některé druhy se častěji rozšiřují v teplejších oblastech nebo podél vodních toků (*Symphoricarpos albus*, *Populus × canadensis*, *Fraxinus excelsior*), kde nacházejí příznivější podmínky. Některé dřeviny se rozrůstají na plochách s xerothermní vegetací (*Ailanthus altissima*, *Prunus spinosa*) a stávají se problémem při managementu v rezervacích.

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