

## 5.6 Integrating black cherry in forest management in the Netherlands and Belgium

*Bart Nyssen, Jan den Ouden, Kris Verheyen and Margot Vanhellemont*

The possibilities of integrating black cherry (*Prunus serotina* Ehrh. var. *serotina*) into the forests on sandy soils in the Netherlands and Belgium is addressed in this chapter. We present a toolbox for forest managers that will help them in integrating black cherry into the forest management. This case study is, in major part, based on the Dutch/Belgian book '*Amerikaanse vogelkers van bospest tot bosboom*' (black cherry, from forest pest to forest tree) (Nyssen et al. 2013).

▶ *Black cherry is a valuable timber species native to North America that was introduced into Europe in the 17<sup>th</sup> century.*

In the eastern part of North America, black cherry is a commonly occurring species and is considered as the most widespread native *Prunus* species on the American continent (Marquis 1990). It can be found within most forest types in the eastern part of North America. However, it only occurs as a co-dominant species in the man-made cherry-maple forest-type. In such forest type, black cherry is a primary component along with red maple (*Acer rubrum* L.), sugar maple (*A. saccharum* Marshall), and white ash (*Fraxinus Americana* L.) (Uchytel 1991).

The first known introduction of black cherry to Europe took place in France in 1623. As for other European countries, black cherry was first planted in Britain in 1629 and in Germany in 1685. In the Netherlands, black cherry was first introduced in 1740 where it was planted in the botanic garden in Leiden. The first introduction in Belgium likely took place at the same time, although it is not properly documented. Since its first introduction to Europe, black cherry has been planted in arboreta, parks and gardens due to its aesthetic qualities (i.e. spring blossoms, summer fruits and colourful foliage in the autumn). At the end of the 19<sup>th</sup> century, black cherry was planted in several species trials in Germany, but also in Belgium and the Netherlands, in order to test its timber production potential (e.g. Schwappach 1896).

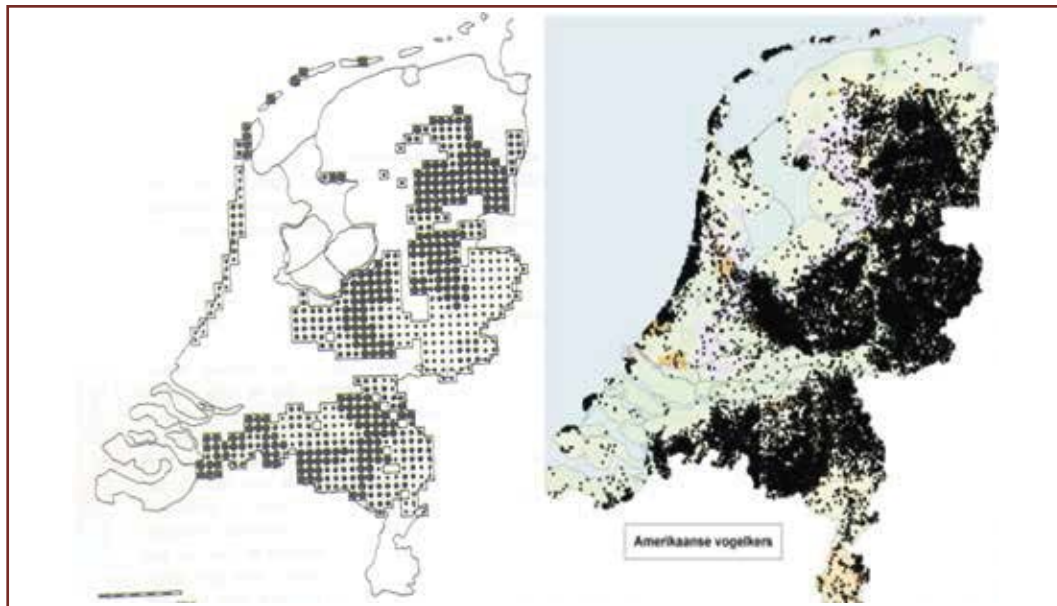
▶ *Black cherry was widely used in forest restoration programmes in the 20<sup>th</sup> century.*

The big expansion of black cherry in the Netherlands took place in the first half of 20<sup>th</sup> century as black cherry started to be used as an admixture species to prevent spread of disease and fire in Scots pine (*Pinus sylvestris* L.) plantations and to enhance litter de-

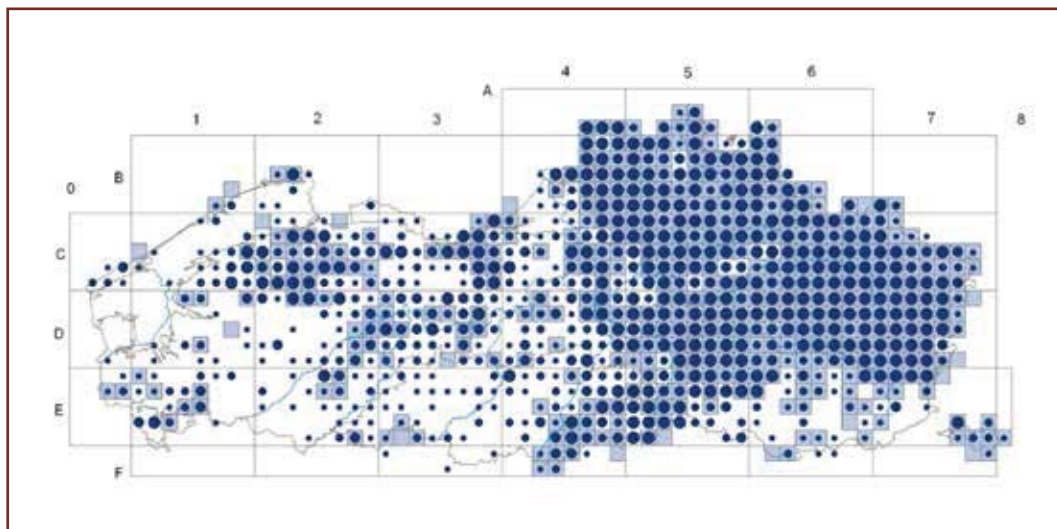
composition. Black cherry was also used to create firebreaks between individual pine stands and to stabilise mobile sand dunes. Black cherry became rather common in the Dutch and Belgian forests starting in 1920s (Muys et al. 1992). Its popularity has also been apparent since the 1950s in the north-western European sand belt where large areas of unproductive land (mainly heathland and drift sand) were reforested with black cherry. In the 1960s it became apparent in the Netherlands that dominance of black cherry on some sites seriously hindered the natural regeneration and plantation of native Scots pine (the main commercial tree species in the Netherlands), which was usually managed using a clearcut system (Figure 101). The natural regeneration of black cherry was already present in the understorey of the mixed Scots pine and black cherry stands, and when the mature Scots pine was clearcut, this regeneration was released and became dominant. Forest managers started to consider black cherry as a contributing factor to reduced biodiversity, and programmes for eradication of black cherry were established (Bakker 1963). These eradication programmes further allowed native species such as silver birch (*Betula pendula* Roth), rowan (*Sorbus aucuparia* L.) and alder buckthorn (*Rhamnus frangula* Mill.) to become more common. With the exception of a period of 'reflection' between 1970 and 1985 (Staatsbosbeheer 1984), the eradication programmes lasted until recently when the rising costs and often limited success of eradication led forest managers to reconsider the status of the species and search for alternative management strategies (Figure 102).



**Figure 101.** Natural regeneration of black cherry in a Scots pine forest following the formation of thinning racks (photo: B. Nyssen).



**Figure 102.** The occurrence of black cherry in the Netherlands before [Iven 1963] and after the eradication programmes [Beringen and Odé 2012].



**Figure 103.** The occurrence of black cherry in northern Belgium; the light blue squares represent the black cherry's spread in the period between 1939 and 1971, while the black circles represent its spread in the period between 1972 and 2004 [Landuyt van 2006].

▶ *Black cherry is naturalised in the north-western European sand belt that reaches from northern Belgium across the Netherlands and Denmark to northern Poland.*

Naturalisation of an introduced species is described as the process during which the species establishes new self-perpetuating populations, undergoes widespread dispersal and becomes incorporated within the resident flora (Richardson et al. 2000). Black cherry affects the composition of the herb layer (Starfinger 1990) and in open vegetation types, such as heathlands, it has a negative impact on the local ecosystem as it directly competes for light with other plants. Black cherry easily colonises heathland similarly to some native tree species such as Scots pine, silver birch and alder buckthorn. In addition, the presence of black cherry is deemed negative when forest owners wish to keep their pine forest in the pioneer stage comprising of Scots pine, silver birch and oak with a herb layer species composition of heliophilous (i.e. light-demanding) plants such as wood sage (*Teucrium scorodonia* L.), hawkweed (*Hieracium* spp.), goldenrod (*Solidago virgaurea* L.) and common cow-wheat (*Melampyrum pratense* L.). The establishment of black cherry mainly changes the light conditions in these forests as it forms a shrub layer similar to that of silver birch, rowan and alder buckthorn. The expansion of black cherry in forests on sandy soils is not considered a problem as such because these forests generally do not contain rare or endangered plant species and high conservation value biotopes (Starfinger and Kowarik 2011). Black cherry acts as late pioneer species shading out light-demanding species such as purple moor grass (*Molinia caerulea* (L.) Moench) and heather (*Calluna vulgaris* (L.) Hull) and promotes typical forest vegetation such as May lily (*Maianthemum bifolium* (L.) F.W. Schmidt) and Solomon's seal (*Polygonatum multiflorum* (L.) All.) (Nyssen et al. 2013; Figure 104).



**Figure 104.** May lily and Solomon's seal in a mature stand of black cherry on sandy soil (photo: J. Tonckens).

▶ *Black cherry is a host for many species that are, in part, the same species also being hosted by native Prunus species such as bird cherry (Prunus padus L.), wild cherry (P. avium L.) and blackthorn (P. spinosa L.).*

Black cherry was recently found harbouring a less dense, but more diverse, herbivore community than the native bird cherry, with similar proportions of specialist and generalist species (Schilthuizen et al. 2016). The herbivory on black cherry doubled over the past century indicating that evolutionary processes may generate a specialised herbivore community developing on an introduced plant; such communities may develop to

an extent that they may reduce the invasive potential of the introduced species over time (Schilthuizen et al. 2016). Many studies have found that a wide range of species are associated with black cherry such as insects (e.g. Nowakowska and Halarewicz 2006, Meijer et al. 2012), birds (e.g. Deckers et al. 2008), mammals (e.g. Sebert-Cuvillier 2008) and fungi (Möller 1998). An example of a butterfly species found on black cherry is the scarce swallowtail (*Iphiclides podalirius* Linnaeus; Figure 105).



**Figure 105.** The native scarce swallowtail caterpillar that can be commonly found on all *Prunus* spp. leaves, including that of black cherry (photos: R. Hille and R. Thassos).



**Figure 106.** This forest manager tried many methods for eradicating black cherry from the native Scots pine forests (e.g. cutting it down, pulling it out or treating its stumps and leaves with glyphosate); now, he is thinking about other solutions (photo: B. Nyssen).

▶ *Many Dutch and Belgian foresters now consider black cherry to be a valuable component of the forest.*

Once black cherry is accepted within the regular forest management, the costs of eradication will disappear and may even be replaced by revenues from timber production. Depending on the timber quality, black cherry timber can be sold at the same price as wild cherry with the prices ranging between €65 and €2 500/m<sup>3</sup> (Van der Burgh et al. 2000). In canopy gaps, black cherry seedlings grow straight stems (e.g. Grundler 2011) and can be integrated in the management of the stand. Currently, three strategic management options are available when managing forests where black cherry is present: eradication, acceptance or enhancing the resilience of the forest. The option chosen depends on the impact black cherry has on the management goals (Petersen et al. 2015). Figure 107 presents a decision scheme for forest owners and managers when choosing a management strategy in forests where black cherry is present.

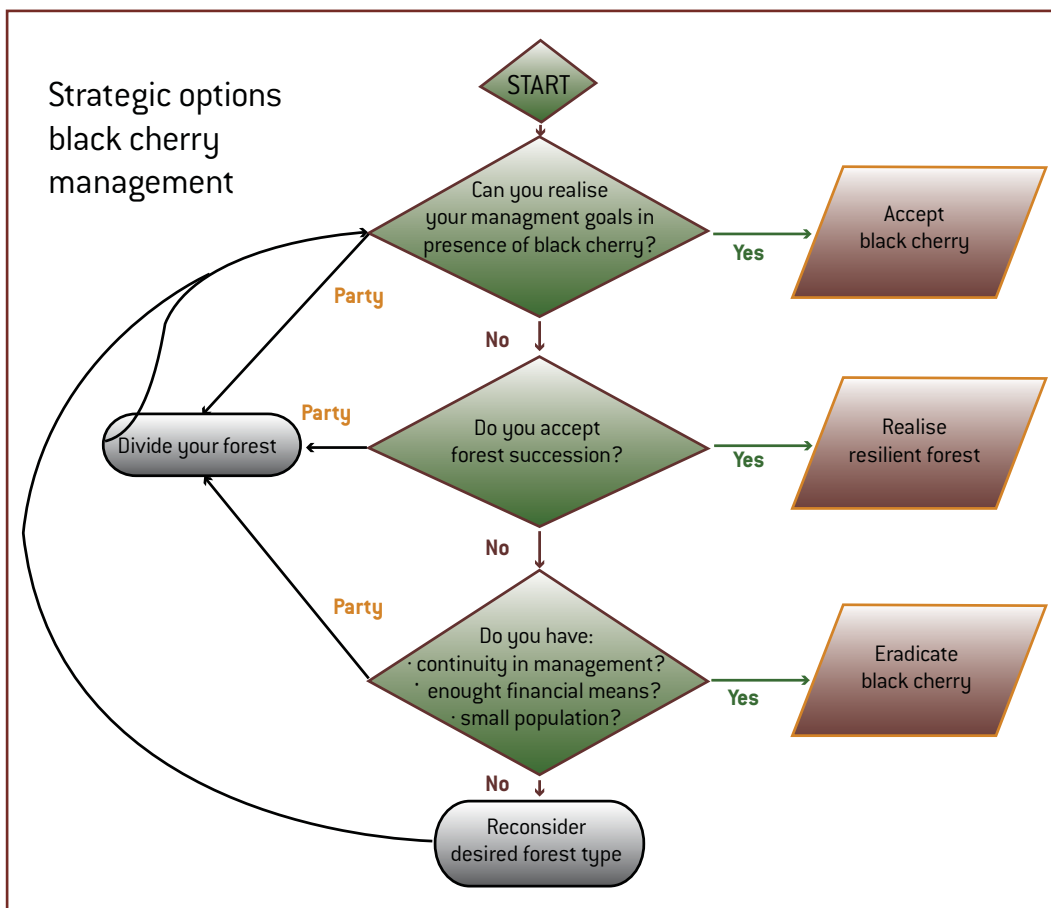


Figure 107. Decision making tool of strategic management options for black cherry.

*Eradication of black cherry is necessary when its presence is incompatible with the goals of forest management.*

Eradication of black cherry is necessary when the objectives of management are to maintain specific open vegetation types, such as heathland, grassland, Natura 2000 forest habitat types (especially 9190 Old acidophilous oak woods with *Q. robur* on sandy plain) or open forest types with light demanding tree species. The best chances for successful eradication are when the population is small and confined, and a systematic approach with a thorough follow-up management is applied. The eradication measures are very costly; the local eradication of black cherry may take up to 20 to 30 years and is done in two phases. In the first phase, the seed trees are removed; a combination of chemical and mechanical measures has proven to be the most effective. The stumps of the trees that had been cut are treated with glyphosate. The cost of this measure is between €200 and €2 200 per hectare for every intervention depending on the abundance and the age of the trees. In the second phase, an inspection of the entire area that had been subjected to the eradication measures is necessary to be applied every five years to prevent the development of new seed trees (Nyssen et al. 2013). On a forest-wide scale, this treatment can be successful as long as the area is frequently monitored and the establishment of new seed trees is prevented. This is necessary because half a century of intensive eradication programmes in the Netherlands – estimated to have cost €200 million – have proven that eradication of black cherry is no longer possible at the landscape scale (Figures 108 and 109). Black cherry seeds are effectively dispersed by birds and mammals (Sebert-Cuvillier 2008), which allows for black cherry seedlings to be established again in open forests.



**Figure 108.** Natural regeneration of black cherry from fox excrement (photo: J. den Ouden).

▶ *This impossibility of eradication at the landscape scale has led forest managers to accept black cherry in their forests.*

When the presence of black cherry does not hinder the fulfilment of management objectives, the acceptance of the species presence may be considered as the most suitable option. If timber production is a management goal, then black cherry is a valuable alternative to wild cherry. In the Netherlands and Belgium, the guidelines for the production of black cherry quality timber (on sandy soils) have been developed using German, Belgian and Dutch experiences; North American guidelines (i.e. Perkey and Wilkins 2001; Box 25) were also considered.

▶ *Absence of late-successional tree species that could compete with black cherry results in the increase of invasibility of these forests.*

Scots pine forests in the eastern parts of the Netherlands and northern parts of Belgium have been planted in the 20<sup>th</sup> century on heathlands and managed with the aim to produce timber. Thus, Scots pine has always been favoured over native broadleaved tree species. The open structure of the even-aged Scots pine stands promoted black cherry invasion. Moreover, late-successional tree species such as European beech (*Fagus sylvatica* L.), hornbeam (*Carpinus betulus* L.), sweet chestnut (*Castanea sativa* Mill.), sycamore (*Acer pseudoplatanus* L.) and small-leaved lime (*Tilia cordata* Mill.), which could compete with black cherry were never planted as the soil conditions of the heathlands were not suited for these species. As a result of this, these late-successional species have had little chance to colonise these forests once the soil conditions have ameliorated. Recent ecological research helps to understand the role of black cherry in the dynamics and functioning of these forest ecosystems (e.g. Verheyen et al. 2007, Vanhellefont 2009).

**Box 25: Management guidelines for black cherry on sandy soils where the aim is timber production**

1. Regenerate under light shelter or in gaps with a minimum width of 10 m and a maximum width of 1.5 times the height of the surrounding trees.
2. Select the desired species composition in mixed natural regeneration groups.
3. Designate control paths in large-scale regenerations.
4. When the crown base is about 2 m, select 200 'option trees' per ha.
5. Inspect every 3 years to make sure the main shoot of the 'option trees' is developing well.
6. Select 40 vital well-formed future crop trees per hectare when the crown basis is at 5 to 6 m height.
7. Gradually free the crop trees from competition to minimise the growth of epicormic shoots growing from the stem; cut a maximum of 1 or 2 competitors.
8. Remove dead branches and prune living branches beneath the desired crown onset height.
9. Subsequently free future crop trees completely every 3 to 6 years.

Black cherry will reach its maximum crown expansion at an age of 45 to 50 years. On sandy soils a diameter at breast height of 50 to 60 cm at age 50- to 80-years-old is possible.



The resilience of a forest against black cherry dominance is promoted by the reduction of light levels in the understorey. The most effective strategy for the reduction of black cherry is the introduction of shade-tolerant and shade-casting species and the creation of multiple crown layers. The replacement of black cherry can be achieved by planting more shade-tolerant tree and shrubs species before there is sufficient light for black cherry to regenerate; i.e. up to 10 % relative light, which are conditions where most shade-tolerant tree species can grow and such conditions can prevent the natural regeneration of black cherry by shading it out (Retter 2004). European beech, hornbeam, lime (*Tilia* spp.), maple (*Acer* spp.), Norway spruce (*Picea abies* (L.) H. Karst.), firs (*Abies* spp.), hazel (*Corylus avellana* L.), rowan, alder buckthorn and holly (*Ilex aquifolium* L.) can be considered amongst the species suitable for this purpose.



**Figure 109.** a) Forest development on sandy soils under black cherry canopy, in the presence of shade tolerant tree species such as European beech, sycamore, sweet chestnut, lime, hazel, holly and yew at Norg (The Netherlands). b) natural establishment of sycamore under black cherry at Kessel (Belgium) (photos: B. Nyssen).

A canopy entirely comprised of black cherry does not hinder the regeneration of most native tree species. In the thicket phase, black cherry casts a lot of shade on the forest floor and prevents shade-intolerant species such as Scots pine and pedunculate oak from establishing. Very shade-tolerant species such as European beech, small-leaved lime and yew can establish below a dense canopy of black cherry that is formed at the early pole stage of black cherry (Hamm et al. 2015a). In the later pole stages, the canopy formed by black cherry becomes sparser enabling the establishment of other species such as sycamore, hazel and sweet chestnut (Niinemets and Valladares 2006). When the black cherry reaches its mature phase, sessile oak (*Quercus petraea* (Matt.) Liebl.), rowan and Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) can establish beneath its canopy. However, it is important to note that if shade tolerant tree species are absent, black cherry replaces itself and dominates the species composition.

The litter of black cherry is easily degradable and enhances the establishment of natural regeneration of late successional species such as small-leaved lime (Hamm et al. 2015b). The litter layer under mature black cherry trees is relatively thin and the survival of seedlings is therefore easier than in the thick litter layers commonly found in, for example, Scots pine forests (where black cherry is absent). This is specifically the case for the late-successional species that profit from the increased nutrient availability of the litter layer and the topsoil under mature black cherry trees (Hamm et al. 2015b). On poor sandy soils, the black cherry leaf litter degrades relatively quickly and increases nutrient availability (Vanderhoeven et al. 2005). This litter enriches the sandy soils that are commonly

dominated by species with litter that does not degrade as quickly, such as Scots pine and oaks (Lorenz et al. 2004). Scots pine stands where black cherry is present can develop a mull or moder humus form instead of the typical mor of pine forests (Bilke 1995). The topsoil under mature black cherry can have significantly higher nutrient concentrations and it can be less acidic than under a Scots pine or oak canopy (Crétin 2013). Black cherry's uptake of nitrogen from the soil is relatively high resulting in a distinct prevention of nitrate leaching into groundwater (Lorenz et al. 2004).

► *Black cherry can be controlled and integrated into forests on sandy soils by reintroducing native tree species that can compete with black cherry in the understorey.*

Where black cherry is dominant, shade-tolerant species can be favoured or introduced. A next step in integrating black cherry is to actually use black cherry, since it has much to offer. It can contribute to biodiversity and soil improvement and its wood is classified as a valuable timber. In the Netherlands, Belgium and neighbouring countries, forest managers have started looking into these new possibilities to cope with black cherry which, depending on the management goals, may either be a great nuisance, or a species with interesting potential.

## References

- Bakker, J. 1963.** *De ontwikkelingsgeschiedenis van Prunus serotina (Amerikaanse vogelkers) en Amelanchier leavis (Drents krenteboompje) in Nederland.* RIVON, Wageningen, The Netherlands.
- Beringen, R. and Odé, B. 2012.** Amerikaanse vogelkers. Nederlands soortenregister. Available at: <http://www.nederlandsesoorten.nl/nsr/concept/0AHCYFCFTWRM/presenceAndDistribution>.
- Bilke, G. 1995.** Ausbreitung, Biomasseproduktion und Nahrelementinkorporation von Strauchschichten aus Spätblühender Traubenkirsche. Unveroff. Diplomarbeit der Fachhochschule Eberswalde, Fachbereich Forstwirtschaft, Germany.
- Crétin, V. 2013.** Prunus and humus, total results. Wageningen Universiteit, Wageningen, The Netherlands.
- Deckers, B., Verheyen, K., Vanhellemont, M., Maddens, E., Muys, B. and Hermy, M. 2008.** Impact of avian frugivores on dispersal and recruitment of the invasive *Prunus serotina* in an agricultural landscape. *Biological Invasions*. 10(5): 717–727. doi:10.1007/s10530-007-9164-3
- Grundler, A. 2011.** Zu Wachstum von Krone und Schaft der Spätblühenden Traubenkirsche (*Prunus serotina*) im Käfertaler Wald, Mannheim. Unpublished Thesis Msc. Hochschule für Forstwirtschaft, Rottenburg, Germany.
- Hamm, T., Huth, F. and Wagner, S. 2015a.** Kiefernforsten renaturieren trotz Spätblühender Traubenkirsche? *AFZ Der Wald*. 70(4): 22–25.
- Hamm, T., Huth, F. and Wagner, S. 2015b.** Spätblühender Traubenkirsche – ein Vorteil für das Keimbett? *AFZ Der Wald*. 70(4): 26.
- Iven, W. 1963.** Bos- en landschapspest. AO-reeks, Vol. 963, Stichting IVIO, Amsterdam, The Netherlands.
- Landuyt van, W., Hoste, I., Vanhecke, L., Vercruyse, W., Van den Bremt, P. and De Beer, D. 2006.** Atlas van de Flora van Vlaanderen en het Brussels Gewest. Instituut voor Natuur- en Bosonderzoek Nationale Plantentuin van België. Brussels, Belgium. P 176.
- Lorenz, K., Preston, C.M., Krumrei, S. and Feger, K.-H. 2004.** Decomposition of needle/leaf litter from Scots pine, black cherry, common oak and European beech at a conurbation forest site. *European Journal of Forest Research*. 123(3): 177–188. doi:10.1007/s10342-004-0025-7
- Marquis D. A. 1990.** *Prunus serotina* Ehrh. Black Cherry. In: Burns, R.M. and Honkala, B.H. (eds.). *Silvics of North America – Hardwoods Handbook* 654. Vol. 2. USDA Forest Service Washington DC. Pp. 594–604.
- Meijer, K., Smit, C., Beukeboom, L.W. and Schilthuizen, M. 2012.** Native insects on non-native plants in The Netherlands: curiosities or common practice? *Entomologische Berichten*. 72(6): 288–293.

- Möller, G. 1998.** Hinweise zur Berücksichtigung von Aspekten des Schutzes holzbewohnender Insekten und Pilze beim Umgang mit neophytischen Gehölzen. *Novius, Mitteilungsblatt der Fachgruppe Entomologie Berlin*. Book 23. Pp. 524-534
- Muys, B., Maddelein, D. and Lust, N. 1992.** Ecology, practice and policy of black cherry (*Prunus serotina* Ehrh.) management in Belgium. *Silva Gandavensis*. 57: 28-45.
- Niinemets, Ü. and Valladares, F. 2006.** Tolerance to shade, drought, and waterlogging of temperate Northern Hemisphere trees and shrubs (main article and app A and B). *Ecological Monographs*. 76(4): 521–547. doi:10.1890/0012-9615(2006)076[0521:TTSDAW]2.0.CO;2
- Nowakowska, K.M. and Halarewicz, A. 2006a.** Coleoptera found on neophyte *Prunus serotina* (Ehrh.) within forest community and open habitat. *Electronic Journal of Polish Agricultural Universities. Series Biology*. 9(1): #5.
- Nyssen, B., den Ouden, J. and Verheyen, K. 2013.** Amerikaanse vogelkers. *Van Bospest tot Bosboom*. KNNV Uitgeverij, Zeist. 160 p.
- Perkey, A.W. and Wilkins, B.L. 2001.** *Crop tree field guide: selecting and managing crop trees in the central Appalachians*. USDA Forest Service, Northeastern Area State and Private Forestry.
- Petersen, R., Annighofer, P., Spellmann, H. and Leder, B. 2015.** Spätblühende Traubenkirsche (*Prunus serotina* Ehrh.). In: Vor, T., Spellmann, H., Bolte, A. and Ammer, C. (eds.). *Potenziale und Risiken eingeführter Baumarten. Baumartenportraits mit naturschutzfachlicher Bewertung*. Göttinger Forstwissenschaften. Band 7. Göttingen, Germany.
- Retter, S. 2004.** Wachstum der Spätblühenden Traubenkirsche (*Prunus serotina*) in Niedersachsen. *Forstamt Lingen*. Unveroff. Diplomarbeit an der Fakultät Ressourcenmanagement der Fachhochschule Göttingen, Germany.
- Richardson, D.M., Pyšek, P., Rejmánek, M., Barbour, M.G., Panetta, D.F. and West, C.J. 2000.** Naturalization and invasion of alien plants: concepts and definitions. *Diversity and Distributions*. 6: 93–107. doi:10.1046/j.1472-4642.2000.00083.x
- Schilthuizen, M., Santos Pimenta, L.P., Lammers, Y., Steenbergen, P.J., Flohil, M., Beveridge, N.G.P., van Duijn, P.T., Meulblok, M.M., Sosef, N., van de Ven, R., Werring, R., Beentjes, K.K., Meijer, K., Vos, R.A., Vrieling, K., Gravendeel, B., Choi Y., Verpoorte, R., Smit C. and Beukeboom, L.W. 2016.** Incorporation of an invasive plant into a native insect herbivore food web. *PeerJ*. 4:e1954 <https://doi.org/10.7717/peerj.1954>
- Schwappach, A. 1896.** *Ergebnisse der Anbauversuche mit japanischen und einigen neueren Amerikanischen Holzarten in Preussen*. Springer Verlag, Berlin.
- Sebert-Cuvillier, E. 2008.** Modélisation de la dynamique invasive du cerisier tardif (*Prunus serotina* Ehrh.) en système forestier tempéré à deux échelles spatiales. PhD Thesis. Université de Picardie Jules Verne, Amiens, France.
- Staatsbosbeheer. 1984.** *Prunus serotina* Ehrh. Beleid en beheer van het Staatsbosbeheer ten aanzien van *Prunus serotina*. Staatsbosbeheer Report. No. 1984(6).
- Starfinger, U. 1990.** Die Einbürgerung der Spätblühenden Traubenkirsche (*Prunus serotina* Ehrh.) in Mitteleuropa. Technische Universität Berlin, Berlin, Germany.
- Starfinger, U. and Kowarik, I. 2011.** *Prunus serotina* Ehrh. (Rosaceae), Späte Traubenkirsche. Bundesamt für Naturschutz. Available at: <http://www.neobiota.de/12631.html>
- Uchytel, R.J. 1991.** *Prunus serotina*. In: *Fire Effects Information System*. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Available at: <http://www.fs.fed.us/database/feis/plants/tree/pruser/all.html>
- Van der Burgh, F., Tünnissen, T., Rövekamp, C. and Goderie, R. 2000.** Boskriek: een nieuwe impuls voor het landelijke gebied. Stichting Robinia, Wageningen, The Netherlands.
- Vanderhoeven, S., Dassonville, N. and Meerts, P. 2005.** Increased topsoil mineral nutrient concentrations under exotic invasive plants in Belgium. *Plant and Soil*. 275(1): 169–179. doi:10.1007/s11104-005-1257-0
- Vanhellemont, M. 2009.** Present and future population dynamics of *Prunus serotina* in forests in its introduced range. PhD Thesis. Universiteit Gent, Gent, Belgium.
- Verheyen, K., Vanhellemont, M., Stock, T., and Hermy, M. 2007.** Predicting patterns of invasion by black cherry (*Prunus serotina* Ehrh.) in Flanders (Belgium) and its impact on the forest understory community. *Diversity and Distributions*. 13(5): 487–497. doi:10.1111/j.1472-4642.2007.00334.x