Crop Protection Compendium - *Acer negundo* L.

Pierre Binggeli 2005

NAMES AND TAXONOMY

Preferred scientific name

Acer negundo L.

Taxonomic position
Domain: Eukaryota
Kingdom: Viridiplantae
Phylum: Spermatophyta
Subphylum: Angiospermae
Class: Dicotyledonae
Order: Sapindales
Family: Aceraceae

Other scientific names
Negundo aceroides Moench
Negundo negundo (L.) Karsten
Rulac fraxinifolia Adanson
Rulac negundo (L.) Hitchc.

BAYER code
ACRNE (*Acer negundo*)

Common names

English:
box elder
ash-leaved maple
ashleaf maple
Spanish:
fresno de Guajuco
arce
French:
erable a feuilles de frene

Canada:
aulne-buis
box-elder maple
inland Manitoba maple
inland box-elder
plaine à giguère
érable
érable argilière
érable du Manitoba
érable négundo
érable à Giguère
érable à Giguère pubescent
érable à feuilles composées
érable à feuilles de frêne
Germany:
Eschen- Ahorn
Eschenahorn
Iran:
afraie-zinati
Italy:
acero a foglie di frassino
acero americano
Poland:
klon jesionolistny
USA:
Manitoba maple
inland boxelder
western boxelder

Notes on taxonomy and nomenclature

Although *A. negundo* is now firmly part of the genus Acer, until relatively recently its taxonomic status has often been debated (de Jong, 1976). The differences, and its reproductive biology (e.g. dioecy) in particular, exhibited by *A. negundo* when compared to other species of the genus lead some taxonomists to ascribe the species to a separate genus *Negundo*. A number of varieties has been described in its native range in North America (Rosario, 1988). These are: var. *negundo* L., var. *interior* (Britt.) Sarg., var. *violaceum* (Kirchn.) Jaeg., var. *texanum* Pax., var. *californicum* Sarg. and var. *arizonicum* Sarg. These varieties are differentiated on the basis of morphological characteristics, mainly pubescence or colour of the branches and/or samaras, and sometimes leaf shape (Anon., 1963; Rosario, 1988). Being an important ornamental tree, many cultivars exist but the variegated forms are the most commonly planted (Gelderen et al., 1994).

HOST RANGE

Notes on host range

Some abandoned pastures, for instance in Poland, are readily colonized by *A. negundo* (Falinski, 1998). It is an occasional invader of cropland and forested areas including plantations.

HABITAT

A. negundo is widespread in riparian and palustrine plant communities and has been reported from a variety of vegetation types in the USA (Rosario, 1988). It is most commonly associated with deciduous forest communities but also occurs in scrub- and grass-dominated vegetation types. In continental Europe it is now common in many urban areas and along many river systems (Sachse, 1991) and in Toronto, Canada it is reported as invading all habitat types (Havinga, 2000). In Europe, *A. negundo* is invading ecosystems that are now rare and protected such as virgin forest, e.g. Bialowieza in Poland (Adamowski et al., 2002) and riparian reserves (Drescher and Magnes, 2002).

GEOGRAPHIC DISTRIBUTION

Notes on distribution

The natural distribution of *A. negundo* ranges from southern Canada to the mountains of Mexico and as far as Guatemala, is absent from western North America but occurs along the Atlantic coast. The various recognized varieties appear to represent fairly distinct geographic races but these often intergrade (Rosario, 1988). The range of the species has greatly expanded in North America through planting and subsequent natural regeneration and is spreading in the western USA. In Canada, although only native to the southern tip of Ontario, *A. negundo* is now naturalized in western provinces from Ontario to Nova Scotia (Anon., 1963). The species is widespread in urban areas throughout much of Europe following centuries of horticultural and landscape planting. It is probably more widespread in other temperate regions of the world but is absent from the tropics.

Distribution List

Europe				
Austria	localized	introduced	invasive	Drescher & Magnes, 2002
Bulgaria	present	introduced		Tutin et al., 1968
Czech Republic	localized	introduced (1835)	invasive	Pysek et al., 2002; Pysek and Prach, 2003
France	present	introduced	invasive	Aboucaya, 1999
Germany	localized	introduced (1736)	invasive	Sachse, 1991; Kowarik, 1992
Hungary	localized	introduced	invasive	Török et al., 2003
Italy	present	introduced		Antonaroli, 1998
Poland	localized	introduced (1800)	invasive	Zajac et al., 1998; Medrzycki & Pabjanek, 2001
[Russian Federation]				
Central Russia	localized	introduced		Adamowski, 1991

Northern Russia	localized	introduced		Adamowski, 1991
Russian Far East	localized	introduced		Adamowski, 1991
Southern Russia	localized	introduced		Adamowski, 1991
Western Siberia	localized	introduced (before 1940)	invasive	Adamowski, 1991
Slovakia	present	introduced (1699)		Tutin et al., 1968; Lohmeyer and Sukopp, 1992
Spain	present	introduced		Tutin et al., 1968
Sweden	localized	introduced	invasive	Stöcklin et al., 2003
Switzerland	present	introduced		Tutin et al., 1968
Ukraine	localized	introduced	invasive	Mosyakin & Yavorska, 2002
United Kingdom	localized	introduced (1688)	not invasive	Clement & Foster, 1994
Asia				
China	present	introduced		Cao et al., 1992
Kazakhstan	present	introduced		Adamowski, 1991
Turkey	present	introduced		Cobanoglu, 1994.
Central America & Caribbean				
Guatemala	present	native		Rosario, 1988
North America				
[Canada]				
Alberta	present	native		Rosario, 1988
Manitoba	present	native		Rosario, 1988
New Brunswick	present	introduced	invasive	Rosario, 1988
Nova Scotia	present	introduced	invasive	Anon., 1961
Ontario	present	native		Rosario, 1988
Prince Edward Island	present	introduced	invasive	Rosario, 1988
Quebec	present	introduced	invasive	Rosario, 1988
Saskatchewan	present	native		USDA-ARS, 2003
Mexico	present	native		Rosario, 1988
[USA]				
Alabama	present	native		Rosario, 1988
Arizona	present	native		Rosario, 1988
Arkansas	present	native		Rosario, 1988
California	present	native		Rosario, 1988
Colorado	present	native		Rosario, 1988
Connecticut	present	native		Rosario, 1988
Delaware	present	native		Rosario, 1988
Florida	present	native		Rosario, 1988
Georgia (USA)	present	native		Rosario, 1988
Idaho	present	native		Rosario, 1988
Illinois	present	native		Rosario, 1988
Indiana	present	native		Rosario, 1988

Iowa	present	native		Rosario, 1988
Kansas	present	native		Rosario, 1988
Kentucky	present	native		Rosario, 1988
Louisiana	present	native		Rosario, 1988
Maine	present	introduced	invasive	Rosario, 1988
Maryland	present	native		Rosario, 1988
Massachusetts	present	native		Rosario, 1988
Michigan	present	native		Rosario, 1988
Minnesota	present	native		Rosario, 1988
Mississippi	present	native		Rosario, 1988
Missouri	present	native		Rosario, 1988
Montana	present	native		Rosario, 1988
Nebraska	present	native		Rosario, 1988
Nevada	present	native		Rosario, 1988
New Hampshire	present	native		Rosario, 1988
New Jersey	present	native		Rosario, 1988
New Mexico	present	native		Rosario, 1988
New York	present	native		Rosario, 1988
North Carolina	present	native		Rosario, 1988
North Dakota	present	native		Rosario, 1988
Ohio	present	native		Rosario, 1988
Oklahoma	present	native		USDA-ARS, 2003
Oregon	present	introduced	invasive	Rosario, 1988
Pennsylvania	present	native		Rosario, 1988
South Carolina	present	native		Rosario, 1988
South Dakota	present	native		Rosario, 1988
Tennessee	present	native		Rosario, 1988
Texas	present	native		Rosario, 1988
Utah	present	native		Rosario, 1988
Vermont	present	native		USDA-ARS, 2003
Virginia	present	native		Rosario, 1988
Washington	present	introduced	invasive	Rosario, 1988
West Virginia	present	native		Rosario, 1988
Wisconsin	present	native		Rosario, 1988
Wyoming	present	native		Rosario, 1988
South America				
Argentina	localized	introduced		Simberloff et al., 2002
Oceania				
[Australia]				
New South Wales	localized	introduced	invasive	Howell & Benson, 2000
Queensland	present	introduced		Groves & Hosking, 1997
Victoria	present	introduced	invasive	Groves & Hosking, 1997
New Zealand	present	introduced	invasive	Webb et al., 1988

HISTORY OF INTRODUCTION AND SPREAD

A. negundo was introduced to the UK in 1688. It was then planted throughout much of Europe but the history of introduction and spread through the continent is fragmentary. It was reported as spreading in Slovakia in 1699 (Lohmeyer and Sukopp, 1992). Pysek and Prach (2003) stated that it was first introduced to the region now known as the Czech Republic in 1835 and first recorded in the wild in 1875. It reached the Brandenburg region of Germany in 1736 (Kowarik, 1992) and the first record in the wild was in 1919, hence a time-lag of 183 years between the species introduction and its spread. In Berlin, the tree was only observed to spread in 1945 (Kowarik, 1992). It was thought to have been introduced to Poland around 1800 (Zajac et al., 1998). In Siberia, *A. negundo* has been cultivated since at least the 1940s and was planted in the Novosibirsk Botanical Garden in 1954 (Adamowski, 1991). In Australia and New Zealand the spread of *A. negundo* is recent; for example, in Australia it was only recorded as naturally regenerating in 1987 (Groves and Hosking 1997, Williams et al., 2002).

BIOLOGY AND ECOLOGY

Genetics

The chromosome number is 2n=26 (Foster, 1933). The sex expression of this dioecious species is believed to be genetically controlled and therefore no sex switching occurs (Dawson and Geber, 1999).

Physiology and Phenology

A. negundo is a fast growing and relatively short lived species with a maximum life span of 100 years but more typically of about 75 years. Sexual dimorphism in *A. negundo* has long been noticed. Lysova and Khiznyak (1976) reported greater height and stem diameter in male compared to female individuals and Ramp and Stephenson (1983) found that males produced more leaf biomass and females more radial growth. Willson (1986) reported that fruit production had no detectable effect on shoot extension growth of female trees compared to male individuals. Fruiting branches grew less than asexual branches in one year out of two but the degree of incremental growth reduction was independent of fecundity levels. These studies indicated that genders responded differently to water availability leading to a segregation of genders (Dawson and Ehleringer, 1993). However, Ward et al. (2002) demonstrated this was true of wet years, with female individuals exhibiting higher growth rate and being more profligate water users, whereas in dry years both sexes showed similar growth and physiological responses. Increasing precipitation would thus favour female trees and also alter the water flux from riparian ecosystems. Flowers of both male and female trees usually appear in spring well before the leaves. The fruits often persist on the tree well into the winter. In North America, large seed crops are produced annually.

Reproductive Biology

Unlike other species of maples which are all hermaphroditic with a wide array of sex expression, *A. negundo* is a dioecious species (de Jong, 1976). The sex ratio is variable and often skewed towards males especially on drier ground away from streamsides (Lysova and Khiznyak, 1976; Sachse, 1992; Ward et al., 2002). The tree may start bearing fruit when it is just 5 years old (Sachse, 1992). There are approximately 30,000 seed/kg (Olson and Gabriel, 1974). The tree is both wind-pollinated and wind-dispersed, although dispersal by birds and squirrels also occurs. Vegetative reproduction is common on damaged

individuals. Exposed or damaged roots will produce new shoots. Shelterbelt trees whose bole had died as a result of drought have been known to recover by producing root sprouts (Rosario, 1988). Germination under test conditions varies widely from 0 to 96% (Williams and Winstead, 1972; Olson and Gabriel, 1974). In the USA, Williams and Winstead (1972) found that northern populations required shorter stratification periods, germinated at colder temperatures and with a higher germination rate than southern populations. Under natural conditions it regenerates readily on disturbed and moist soils and does tolerate medium shade (Rosario, 1988) but poor establishment or high seedling mortality occurs in dense ground cover or under closed canopy (Sachse, 1992).

Environmental Requirements

A. negundo is generally a temperate species tolerant of a wide range of environmental conditions. It is tolerant to water logging (Howell and Benson, 2000) and is highly sensitive to water stress (Ward et al., 2002), but it is also recognized as a drought-tolerant tree once established (Rosario, 1988). Dawson and Ehleringer (1991) have shown that juveniles depend solely on precipitation or stream water for approximately the first ten years, whereas older trees rely on groundwater. Although often classified as pioneer species (Tickner et al., 2001) it is moderately shade-tolerant (Niinemets, 1998). This fast-growing species is hardy and is resistant to cold (Rosario, 1988). In North America, its upper and lower altitudinal range varies greatly ranging from 680 to 3048 m with a range no greater than 1800 m and usually less than 500 m in any one state (Rosario, 1988). Branches readily break during stormy weather and being thin-barked, trees are readily injured by fire (Rosario, 1988).

Associations

As *A. negundo* favours disturbed ground and higher light intensities it becomes established in the earlier stages of succession.

Climatic amplitude (estimates)
- Altitude range: 0 - 3050 m
- Mean annual rainfall: 400 - 2000 mm
- Dry season duration: 0 - 4 months

Soil descriptors
- Soil texture: light; medium; heavy
- Soil drainage: free; impeded; seasonally waterlogged
- Soil reaction: acid; neutral
- Special soil tolerances: shallow; saline
- Soil types: clay soils; silty soils; sandy soils;

MEANS OF MOVEMENT AND DISPERSAL

Natural Dispersal (Non-Biotic)

A. negundo, like all other maple species, is chiefly wind-dispersed. Dispersal in maples is usually localized, no more than 100 m from the seed source, but may occasionally be spread over several kilometres if seeds are released when hard snow lies on the ground and very windy weather prevails (Binggeli, 1992). In riparian systems, samaras are probably also dispersed by water but the importance of this dispersal mechanism is unclear.

Vector Transmission (Biotic)

Limited dispersal by birds and squirrels may occur.

Agricultural Practices

In several parts of the world the tree has been extensively planted in hedges and as a windbreak. The current importance of this practice, and in its introduced range in particular, is unknown.

Accidental Introduction

There is a low risk of accidental introductions.

Intentional Introduction

Because *A. negundo* is an important ornamental tree species with a number of varieties, nearly all new introductions will be intentional. Even where already present the introduction of new varieties/ecotypes may result in the establishment of weedy strains.

NATURAL ENEMIES

A number of insect pests or fungal diseases have been noted on *A. negundo* (e.g. Gilman and Watson, 1993) but few have been reported to adversely affect the species. It is susceptible to heartrot and some insect pests but these rarely kill it. The boxelder bug, *Boisea trivittata* (Say) feeds primarily on seed-bearing trees by sucking sap from the leaves, tender twigs and developing fruits, and although they cause little damage they are a nuisance in dwellings (Vail et al., 2002).

IMPACT

Economic impact

No relevant instances are documented, but it has been reported that the tree may be poisonous to livestock (Rosario, 1988).

Environmental impact

Sediment deposition in an *A. negundo* stand was found to be greater than in native vegetation after a major flood event (8.4 ± 0.4 kg/m² vs 5.8 ± 0.7 kg/m²) (Brunet and Astin, 1997). Other effects of *A. negundo* on the environment have not been quantified.

Social impact

This species does not to have deleterious attributes such as spines or health-inducing risks and as such probably has limited social impacts. However, in the USA the insect *Boisea trivittata* (Say), after feeding on pistillate trees, over-winters on or near buildings. In spring, when it starts disperse to breed, this largish insect (over 1 cm long), may enter houses in large numbers and stain walls and curtains with brown faecal material. When crushed they produce a foul odour and may bite if handled carelessly (Vail et al., 2002). This harmful social impact has yet to be reported from Europe and other regions where the

species has been introduced.

Impact on biodiversity

No relevant instances are documented. As it becomes a major component of the ecology of European riparian vegetation, its presence will probably result in a shift in species composition reducing the presence of some species. For instance, in France *A. negundo* is now an important component of the Loire Valley vegetation but its impact on the populations of the re-introduced European beaver is unknown (Fustec et al., 2001).

Summary of impact

Negative impact on: biodiversity; crop production; forestry production

PHYTOSANITARY SIGNIFICANCE

In Australia, a native alternative to *A. negundo* is being promoted and more species are to be identified by the horticultural trade (Lewis and Stephens, 2001). In New Zealand, as part of a Conservation Weed Risk assessment it has gained a relatively high score but experts have ranked the species as a minor weed because it has yet to become a conservation weed (Williams et al., 2002).

SUMMARY OF INVASIVENESS

A. negundo is a small and variable tree of little economic value native to much of North America. It has been widely planted mainly for amenity purposes in non-native parts of North America, Europe and Asia where it is now regenerating freely and spreading, invading riparian zones and urban areas. In the temperate parts of the southern hemisphere the spread of *A. negundo* is more limited. Although this pioneer species is invasive throughout much of its introduced range, actual impacts are not great. This species has no important negative impacts on human activities. In natural habitats the species becomes an important component of the vegetation in riparian systems and increases siltation.

Risk and Impact Factors

- invasive in its native range: unknown
- proved to be invasive outside its native range: yes
- highly adaptable to different environments: yes
- high reproductive potential: yes
- highly mobile locally: unknown
- its propagules remain viable for more than one year: no
- tolerates cultivation, browsing pressure, mutilation, fire etc.: yes
- competitive in crops or pasture: no
- affects ecosystem: yes
- adversely affects natural communities: unknown
- adversely affects community structure: yes
- adversely affect human health: no
- has sociological impacts on recreational patterns, aesthetics, property values: unknown
- harmful to animals: no
- produces spines, thorns or burrs: no

- host or vector of pests or diseases: no
- likely to be accidentally transported internationally: no
- likely to be deliberately transported internationally: yes
- difficult to identify or detect as a commodity contaminant: no
- difficult to identify or detect in the field: no
- difficult or costly to control: no

MORPHOLOGY

Plant type: tree; woody; vegetatively propagated; seed propagated; perennial.

A. negundo is an often multi-stemmed tree reaching a height of no more than 20 m and a stem diameter of up to 1 m (Rosario, 1988). In more open vegetation the canopy usually exhibits a broad and open crown and may even become shrubby, whereas in the face of competition in a forest stand the trunk tends to be single-stemmed and straighter. Shoots are green and turn violet in the second year. The bark is grey-brown becoming dark grey and is shallowly cracked. Buds are opposite, small, 2-5 mm, two-scaled and silky white. The leaves are 15-35 cm long, pinnate with 3-5 (or 7) leaflets and light green but paler below. The leaflets are lobed and serrated. Leaflet shape is variable, for instance in var. interior the first pair of leaflets is 3-lobed. Male flowers are born in corymbs with pendent stamens whilst female flowers are in small pendent racemes. Both types of flowers are small and pale yellowish-green in colour. There is much variation in the morphology of pistillate flowers with the presence of stamens on a proportion of the flowers (Hall, 1951). The fruit consists of two fused winged samaras to 4 cm long, diverging at an angle of less than 60 degrees. The samaras separate when shed and contain a single wrinkled seed.

SIMILARITIES TO OTHER SPECIES

If no fruiting material is observable, the species, because of its mainly pinnate foliage, could be readily ascribed to a genus other than *Acer*. However, when present, the distinct samaras clearly indicate that the species belongs to the maple (Aceraceae) family.

CONTROL

To date, little effort has been undertaken to control this species although its control has been advocated, for instance in Austria (Drescher and Magnes, 2002). No information is available for cultural, chemical or mechanical control although cutting and stump treatments used on other tree species may prove effective. *A. negundo* has not been considered for biological control though numerous insect pests are recorded on the species. The use of male trees only in amenity planting would eliminate risks of spread in the introduced range.

USES

Little economic use is made of this species as its timber has undesirable characteristics, being light, soft, close grained and of low strength. Locally, the wood may be used to make boxes and in rough construction, but it is only occasionally used to produce cheap furniture and other wooden products. Formerly, the wood was used for posts, fencing and fuel. However, it is a poor fuel as the wood is soft and spongy (Rosario, 1988). In North America, the foliage of *A. negundo* has poor nutritional value for livestock. It is a browse

species of secondary importance to deer whereas the seeds are an important food source for birds and squirrels. It has a good value as cover for both wildlife and livestock and has been used to revegetate riparian areas (Rosario, 1988).

PESTS

Pests listed in the database

Major host of:
Anoplophora glabripennis (Asian longhorned beetle), *Pseudomonas syringae* pv. *aceris* (leaf spot), *Thyridopteryx ephemeraeformis* (evergreen bagworm), *Tremex fuscicornis* (Tremex wasp)

Minor host of:
Acrosternum hilare (green stink bug), *Anoplophora chinensis* (black and white citrus longhorn), *Chaetocnema confinis* (flea beetle), *Eulecanium tiliae* (nut scale), *Fomitiporia mediterranea* (esca disease), *Ganoderma lucidum* (basal stem rot: Hevea spp.), *Lymantria dispar* (gypsy moth), *Melolontha melolontha* (white grub cockchafer), *Orgyia leucostigma* (white-marked tussock moth)

Wild host of:
Fomitopsis pinicola (brown crumbly rot), *Hyphantria cunea* (mulberry moth), *Longidorus* (longidorids), *Peridroma saucia* (pearly underwing moth), *Pratylenchus penetrans* (nematode, northern root lesion)

Host of (source - data mining):
Boisea trivittata (boxelder bug), *Corthylus punctatissimus* (pitted ambrosia beetle), *Leptocoris trivittatus* (boxelder bug), *Parthenolecanium persicae* (peach scale), *Uncinula bicornis* (powdery mildew: *Acer* spp.)

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