

Information on measures and related costs in relation to species considered for inclusion on the Union list – *Celastrus orbiculatus*

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Date of completion: 09/04/2021

Comments which could support improvement of this document are welcome. Please send your comments by e-mail to ENV-IAS@ec.europa.eu.

Species (scientific name)	<i>Celastrus orbiculatus</i> Thunb.
Species (common name)	Oriental bittersweet, staff vine
Author(s)	Johan van Valkenburg, National Plant Protection Organization, Geertjesweg 15 / P.O. Box 9102, 6700 HC Wageningen, Netherlands
Date Completed	09/04/2021
Reviewer	Jonathan Newman, Senior Advisor Biologically Active Substances, Environment and Business, Environment Agency Giuseppe Brundu, Department of Agricultural Sciences, University of Sassari, 07100 Sassari, Italy

Summary of the most effective measures

Summarise the most effective measures discussed below for each category highlighting cost-effectiveness where known. There is no need to summarise the species invasion status within the EU, or its taxonomy etc., which are dealt with in the species Risk Assessment.

Prevent intentional introduction into the territory:

As the species is found within the horticultural trade, banning its import and sale would be an effective preventative measure. The control of the species poses challenges once it has become established. Therefore, to prevent introductions in unaffected EU Member States (MS) or further spread into the areas where this species is not yet present, it is important to act at the earliest stage of invasion and to prevent additional introductions and further spread in those areas in which it is already present so as to avoid costs linked to managing the species when widely established. Containment and control are likely to be costly, which reinforces the need for preventive action in the area at risk.

Prevent intentional release or unintentional escape into the environment [if relevant]: N/A

Prevent reproduction in captivity [if relevant]: N/A

Prevent un-intentional introduction into the territory: The species is not known to be introduced un-intentionally.

Prevent secondary spread: The species has a long history in horticulture in the European Union and has long since been planted in botanical gardens and public parks as well as private gardens. The species can be spread via dispersal of seed by animals, though mechanical control prior to seed formation can address this. It is still readily available from horticultural outlets and from online stores both as potted plants (including as bonsai), as well as seed. A niche market for cut branches bearing ripe fruits exists. A ban on sale of plants, cut branches and seed would be an effective measure to prevent further spread.

Achieve early detection:

Early detection and rapid eradication is critical for limiting the spread of bird and mammal dispersed plants. Early detection could be achieved by incorporating the species in a more comprehensive citizen science IAS monitoring system in combination with a general public awareness campaign.

Rapid eradication:

Rapid response to control small scale infestations already reported in the EU is essential. Physical removal of small patches may be successful through careful and thorough hand-pulling and uprooting the plants. Exclusively mechanical control options on *C. orbiculatus* have not been studied in detail yet, although purely mechanical control in the second year of treatment appears to be more than 90% effective for plants of large stem diameter. Chemical control of individual plants can be achieved successfully and a combination of stem cutting or mowing with a follow up application of a gel based herbicide to cut stems is also effective.

Management (e.g. eradication, population control, containment):

Despite a long, well documented history as an invasive plant in North America, no detailed studies of effective management of large infestations have been published yet. Whereas efficacy of chemicals is mentioned no actual reports of large scale application of integrated management combining stem cutting or mowing and systemic herbicides could be found. There are no known biological control agents for the species.

Prevention of intentional introductions - measures for preventing the species being introduced intentionally into the territory of a Member State. **This table is for a single measure, and the table is repeated for each separate prevention measure identified.**

Measure name	Prohibition of import, sale, transport, exchange, breeding and release					
<p>Measure description Provide a description of the measure and its objective, noting the pathway of introduction being addressed. If relevant, include a summary of the methodology to apply the measure, with references to sources of information where detail can be found (e.g. best practices, standard operating procedures etc.).</p>	<p>Prohibition of import, sale, transport, exchange, breeding and release of this species will prevent its wider introduction, secondary spread and establishment across the EU. Although the import of rooted plants and cuttings (except for bonsai) into the European Union is largely historical (most plants for sale are produced within the EU), a prohibition of imports will prevent new genetic material arriving that may increase risk of invasiveness. At present seed can still be bought via various internet sources (EPPO, 2021).</p>					
<p>Scale of application At what geographic scale is the measure applied? What is the largest scale at which it has been successfully used? Please provide examples reporting areas (km² or ha) if possible.</p>	<p>The measure has to be applied EU wide. Previous bans of import have been likewise applied for plants on the Union list.</p>					
<p>Effectiveness of the measure Is it effective in relation to its objective? Based on cases where the measure has been applied (ideally correctly and comprehensively), please select one of the categories of effectiveness (with an 'X'), and provide a rationale, with supporting evidence and examples of effectiveness, if possible. Please identify factors that are critical in determining its effectiveness.</p>	<p><i>Effectiveness of measures</i></p>	<p><i>Effective</i></p>	<p>X</p>	<p><i>Neutral</i></p>	<p><i>Ineffective</i></p>	<p><i>Unknown or not yet applied</i></p>
<p><i>Rationale:</i> Prohibition of import, assuming compliance, will effectively reduce the risk of new genetic material arriving that might increase the risk of invasiveness of the species.</p>						

<p>Please note if effectiveness is based on research only (e.g. field or experimental trials).</p>																																		
<p>Effort required e.g. Number of times, and/or period of time over which measure needs to be applied to have results achieve its objective (please indicate the units)</p>	<p>In general, considerable effort is needed to train staff, develop identification tools for border customs control and communicate the measures to stakeholders and the general public.</p>																																	
<p>Resources required¹ e.g. cost, staff, equipment etc. Please note the resources (and their costs if available) that are required to implement the measure to meet its objective.</p>	<p>This is difficult to estimate and will vary between MS's. No published data are available.</p>																																	
<p>Additional cost information¹ When not already included above, or in the species Risk Assessment. - implementation cost for Member States - the cost of inaction - the cost-effectiveness - the socio-economic aspects</p> <p>Include quantitative &/or qualitative data, and case studies (incl. from countries outside the EU).</p>	<p>No additional cost information is available.</p>																																	
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<p>For each of the side effect types please select one of the categories (with an 'X'), and provide a rationale, with supporting evidence and examples if possible.</p> <p>NOTE – this does not refer to direct intended effects of the measure (e.g. a reduction of the IAS population, or an increase in native species)</p>											
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<p>Level of confidence on the information provided²</p> <p>Please select one of the confidence categories along with a statement to support the category chosen. See <i>Notes</i> section at the bottom of this document.</p> <p>NOTE – this is not related to the effectiveness of the measure</p>	<p><i>Rationale:</i> Considering the very limited volume, the economic impact of a ban of imports from outside the EU is not expected to be challenged.</p> <p><i>Rationale:</i> There is available information to show that the species is still being sold within the EU. An import ban is the only realistic measure to prevent such introductions, however established information on the effectiveness of such a ban is lacking.</p>										
<i>Inconclusive</i>			<i>Unresolved</i>			<i>Established but incomplete</i>		X	<i>Well established</i>		

<p>Prevention of escape or release into the environment – measures for preventing the species escaping from containment into the environment (cf. Articles 8, 9, 17, 19, 31, and 32 of the IAS Regulation). This table is repeated for each of the prevention measures identified.</p>	
Measure name	DOES NOT APPLY

<p>Measure description Provide a description of the measure and its objective, noting the pathway of introduction being addressed If relevant, include a summary of the methodology to apply the measure, with references to sources of information where detail can be found (e.g. best practices, standard operating procedures etc.).</p>									
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<p>Prevention of reproduction of contained specimens – measures for preventing the species reproducing while in containment (cf. Articles 17, 18, 31, and 32 of the IAS Regulation). This table is repeated for each of the prevention measures identified.</p>	
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<p>Prevention of <u>un-intentional</u> introductions – measures for preventing the species being introduced un-intentionally into the territory of a Member State (cf. Article 13 of the IAS Regulation). This table is repeated for each of the prevention measures identified.</p>	
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Rationale:

| **Acceptability to stakeholders** e.g. impacted economic activities, animal welfare considerations, public perception, etc. Please select one of the categories of acceptability (with an 'X'), and | | | | | |--------------------------------------|-------------------|--------------------------| | <i>Acceptability to stakeholders</i> | <i>Acceptable</i> | <input type="checkbox"/> | |--------------------------------------|-------------------|--------------------------| | | | | |-------------------|--------------------------| | <i>Acceptable</i> | <input type="checkbox"/> | |-------------------|--------------------------| | | | | |--------------|--------------------------| | <i>Mixed</i> | <input type="checkbox"/> | |--------------|--------------------------| | | | | |---------------------|--------------------------| | <i>Unacceptable</i> | <input type="checkbox"/> | |---------------------|--------------------------| | | | | |---------------------|--------------------------| | <i>Unacceptable</i> | <input type="checkbox"/> | |---------------------|--------------------------| | | | | |----------------|--------------------------| | <i>Unknown</i> | <input type="checkbox"/> | |----------------|--------------------------| | | | |--------------------------| | <input type="checkbox"/> | |--------------------------| |

Rationale:

provide a rationale, with supporting evidence and examples if possible.								
Level of confidence on the information provided ²	<i>Inconclusive</i>	<input type="checkbox"/>	<i>Unresolved</i>	<input type="checkbox"/>	<i>Established but incomplete</i>	<input type="checkbox"/>	<i>Well established</i>	<input type="checkbox"/>
Please select one of the confidence categories along with a statement to support the category chosen. See <i>Notes</i> section at the bottom of this document. NOTE – this is not related to the effectiveness of the measure	<i>Rationale:</i>							

Prevention of <u>secondary spread of the species</u> – measures for preventing the species spreading within a Member State once they have been introduced (cf. Article 13 of the IAS Regulation). This table is repeated for each of the prevention measures identified.	
Measure name	Prohibition of sale, transport, exchange, breeding and release
Measure description Provide a description of the measure and its objective, noting the pathway of spread being addressed If relevant, include a summary of the methodology to apply the measure, with references to sources of information where detail can be found (e.g. best practices, standard operating procedures etc.).	Along with an import ban, prohibition of ‘post border’ sale, transport, exchange, breeding and release of this species will support the prevention of its wider establishment across the EU. (Inter-)national trade of horticultural material is considered the major pathway for secondary spread of the species (EPPO 2021). The species is spread via movement of seeds by animals, with birds being important vectors. Gudžinskas et al. (2020) suspect that at least one of the known Lithuanian sites, situated under low-voltage power lines, is a result of bird dispersal from areas of cultivation. In North America the European starling is known as a vector of the species (White et al. 1992 in Fryer 2011). See the <i>Mechanical control aiming at preventing fruit formation</i> table below on how to address this pathway.
Scale of application At what geographic scale is the measure applied? What is the largest scale at which it has been successfully used?	The measure has to be applied EU wide. Previous bans of import have been likewise applied for plants on the Union list.

Please provide examples reporting areas (km ² or ha) if possible.								
<p>Effectiveness of the measure Is it effective in relation to its objective?</p> <p>Based on cases where the measure has been applied (ideally correctly and comprehensively), please select one of the categories of effectiveness (with an 'X'), and provide a rationale, with supporting evidence and examples of effectiveness, if possible.</p> <p>Please identify factors that are critical in determining its effectiveness.</p> <p>Please note if effectiveness is based on research only (e.g. field or experimental trials).</p>	<p><i>Effectiveness of measures</i></p>	<p><i>Effective</i></p>	<p>X</p>	<p><i>Neutral</i></p>		<p><i>Ineffective</i></p>	<p><i>Unknown or not yet applied</i></p>	
<p>Effort required e.g. Number of times, and/or period of time over which measure needs to be applied to have results achieve its objective (please indicate the units)</p>	<p><i>Rationale:</i> Prohibition of sale, assuming compliance and enforcement, will effectively reduce the risk of fruit bearing branches being discarded unwisely or new plants being planted in a suitable habitat, thereby reducing the potential propagule pressure on natural areas.</p> <p>In the United States the species is not subject to regulation at federal level, though various levels of regulation apply for individual States (USDA Plants Database, 2021). The species was already widely established prior to State level regulations, it is therefore difficult to judge the effect of such listing the species. Likewise the listing of the species in New Zealand in 2001, was at a time the species was already established in numerous natural areas on both the North and South Island. Present day occurrences across the EU are far more limited and of fairly recent date (EPPO, 2021),</p> <p>In general, considerable effort is needed to enforce such measures, including train staff, develop identification tools and communicate the measures to stakeholders and the general public.</p>							
<p>Resources required¹ e.g. cost, staff, equipment etc. Please note the resources (and their costs if available) that are required to implement the measure to meet its objective.</p>	<p>This is difficult to estimate and will vary between MS's. No published data are available.</p>							
<p>Additional cost information¹ When not already included above, or in the species Risk Assessment. - implementation cost for Member States - the cost of inaction</p>	<p>No additional cost information is available.</p>							

<p>- the cost-effectiveness - the socio-economic aspects</p> <p>Include quantitative &/or qualitative data, and case studies (incl. from countries outside the EU).</p>											
<p>Side effects (incl. potential) – both positive and negative i.e. positive or negative side effects of the implementation of the measure (not the IAS itself) on public health, environment including non-targeted species, etc. For example, native species non-target impacts from trapping.</p> <p>For each of the side effect types please select one of the categories (with an 'X'), and provide a rationale, with supporting evidence and examples if possible.</p> <p>NOTE – this does not refer to direct intended effects of the measure (e.g. a reduction of the IAS population, or an increase in native species)</p>	<p>Environmental effects</p>	<p>Positive</p>		<p>Mixed</p>		<p>Negative</p>		<p>None</p>	<p>X</p>	<p>Unknown</p>	
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	<p>Economic effects</p>	<p>Positive</p>		<p>Mixed</p>	<p>X</p>	<p>Negative</p>		<p>None</p>		<p>Unknown</p>	
	<p><i>Rationale:</i> Reducing potential propagule pressure on the environment can be considered as positive. A ban on sale will reduce the availability of a plant which was appreciated by the public. It will have an economic effect on those producing the plants or cut branches, that will miss out on a part of their income or divert their attention to another similar plant species to make up for the loss of <i>Celastrus orbiculatus</i>. Ideally (future) cost of management of the species will be reduced.</p>										
<p>Acceptability to stakeholders e.g. impacted economic activities, animal welfare considerations, public perception, etc.</p> <p>Please select one of the categories of acceptability (with an 'X'), and provide a rationale, with supporting evidence and examples if possible.</p>	<p>Acceptability to stakeholders</p>	<p>Acceptable</p>		<p>Mixed</p>	<p>X</p>	<p>Unacceptable</p>		<p>Unknown</p>			
	<p><i>Rationale:</i> Rooted plants are of marginal importance to the horticultural trade (Pers. Comm. representative of Dutch umbrella organisation). The production of the cut branches is a niche market, some individual growers will have to divert their activities to another plant species.</p>										
<p>Level of confidence on the information provided ²</p>	<p>Inconclusive</p>	<p>X</p>	<p>Unresolved</p>		<p>Established but incomplete</p>		<p>Well established</p>				

<p>Please select one of the confidence categories along with a statement to support the category chosen. See <i>Notes</i> section at the bottom of this document.</p> <p>NOTE – this is not related to the effectiveness of the measure</p>	<p><i>Rationale:</i> Evidence is based not so much on published sources but on expert opinion</p>
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Surveillance measures to support early detection - Measures to run an effective surveillance system for achieving an early detection of a new occurrence (cf. Article 16). This section assumes that the species is not currently present in a Member State, or part of a Member State's territory. This table is repeated for each of the early detection measures identified.	
Measure name	Incorporation of the species in citizen science reporting/ monitoring tools.
<p>Measure description Provide a description of the measure and its objective If relevant, include a summary of the methodology to apply the measure, with references to sources of information where detail can be found (e.g. best practices, standard operating procedures etc.).</p>	<p>The early detection of invasive alien plant species is a key factor in the successful eradication of new infestations (Genovesi et al., 2010). Early detection in combination with a rapid response is a proactive approach, focussed on the successful management of alien species prior to their establishment. After the early detection of a species, well-coordinated rapid management measurements are required, which must take into account the specific biology and habitat characteristics to achieve the total eradication of the target species.</p> <p>Citizen science in combination with a national coordinating body may well be a suitable approach. Citizen scientists have surveyed for and monitored a broad range of taxa, and also contributed data on weather and habitats reflecting an increase in engagement with a diverse range of observational science. Citizen science has taken many varied approaches from citizen-led (co-created) projects with local community groups to, more commonly, scientist-led mass participation initiatives that are open to all sectors of society. Citizen science provides an indispensable means of combining environmental research with environmental education and wildlife recording (Roy et al., 2012). The problem of early detection by citizen science in the case of <i>Celastrus orbiculatus</i> is that it is difficult to identify the species accurately because of the absence of striking morphological features when not in flower or fruit. Visibility of the species is most evident in autumn when leaves turn yellow and, if present, fruits will be clearly visible because of the orange-red colour. A field guide that helps key stakeholder groups (e.g. land managers, foresters) identify the species, as well look-a-like species, would support this measure.</p>

<p>Scale of application At what geographic scale is the measure applied? What is the largest scale at which it has been successfully used? Please provide examples reporting areas (km² or ha) if possible.</p>	<p>Citizen science monitoring/reporting tools are usually applied nationwide at the largest scale. Some examples are waarneming.nl and waarneming.be. A field guide along the lines of that already produced by NVL could be produced at the national scale (e.g. NVWA, 2019), or even at the EU level (e.g. IUCN, 2018).</p>								
<p>Effectiveness of the measure Is it effective in relation to its objective? Based on cases where the measure has been applied (ideally correctly and comprehensively), please select one of the categories of effectiveness (with an 'X'), and provide a rationale, with supporting evidence and examples of effectiveness, if possible. Please identify factors that are critical in determining its effectiveness. Please note if effectiveness is based on research only (e.g. field or experimental trials).</p>	<p><i>Effectiveness of measures</i></p>	<p><i>Effective</i></p>	<input type="checkbox"/>	<p><i>Neutral</i></p>	<input type="checkbox"/>	<p><i>Ineffective</i></p>	<p><i>Unknown or not yet applied</i></p>	<p><i>X</i></p>	<p><i>Rationale:</i> Delaney et al. (2008) successfully used the data collected by citizen scientists to create a large-scale standardized database of the distribution and abundance of native and invasive crabs along the rocky intertidal zone in Massachusetts, USA. An assessment of the accuracy of data collected by citizen scientists showed that, depending on experience, between 80 and 95% accuracy in identification was achieved (Delaney et al., 2008). In the case of <i>C. orbiculatus</i> this percentage may be lower in the absence of flowers or fruit, hence the assessment of effectiveness as 'unknown'. However, the increasing use of image based smartphone identification tools may increase the level of accuracy (see Johnson et al. 2020). A first sighting of <i>Gymnocoronis spilanthoides</i> in the Netherlands in 2019 reported in www.waarneming.nl, resulted in a coordinated eradication action by municipality, water board and provincial authority (van Valkenburg & Odé 2020).</p>
<p>Effort required e.g. Number of times, and/or period of time over which measure needs to be applied to have results achieve its objective (please indicate the units)</p>	<p>Roy et al. (2012) state that “Environmental monitoring relies on long-term support in terms of volunteer liaison, data handling, quality assurance, publication and statistical support for measuring trends, requiring the involvement of a professional scientific organisation. The use of volunteers in Citizen science is critical for the success and is supported at a European-level through the SEBI (Streamlining European 2010 Biodiversity Indicators) “public awareness indicator” which reported that over two-thirds of EU citizens report personally making efforts to help preserve nature. The Pan-European SEBI initiative was launched in 2005. SEBI aims to develop a European set of biodiversity indicators to assess and inform European and global biodiversity targets. SEBI links the global framework, set by the Convention on Biological Diversity (CBD), with regional and national indicator initiatives. Many of the headline indicators rely entirely on the availability of monitoring data and particularly datasets on biodiversity developed by volunteer naturalists (Levrel et al., 2010)”.</p>								
<p>Resources required¹ e.g. cost, staff, equipment etc.</p>	<p>Integration of accurate citizen science requires a coordinating scientific or government body. Normally the work would be funded by research grant funding, or by direct funding of scientific organisations by MS Governments.</p>								

<p>Please note the resources (and their costs if available) that are required to implement the measure to meet its objective.</p>	<p>Annual costs for running citizen science projects in 2007 – 2008 were estimated at between €80,000 and €170,000 (Roy et al., 2012).</p>																																										
<p>Additional cost information ¹ When not already included above, or in the species Risk Assessment. - implementation cost for Member States - the cost of inaction - the cost-effectiveness - the socio-economic aspects</p> <p>Include quantitative &/or qualitative data, and case studies (incl. from countries outside the EU).</p>	<p>No additional cost information exists.</p>																																										
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<p>e.g. impacted economic activities, animal welfare considerations, public perception, etc.</p> <p>Please select one of the categories of acceptability (with an 'X'), and provide a rationale, with supporting evidence and examples if possible.</p>	<p><i>Rationale:</i> Generally, this technique is accepted by stakeholders, and involvement with research and the scientific community tends to increase acceptance of public funding of such bodies.</p>								
<p>Level of confidence on the information provided ²</p> <p>Please select one of the confidence categories along with a statement to support the category chosen. See <i>Notes</i> section at the bottom of this document.</p> <p>NOTE – this is not related to the effectiveness of the measure</p>	<p><i>Inconclusive</i></p>		<p><i>Unresolved</i></p>		<p><i>Established but incomplete</i></p>	<p>X</p>	<p><i>Well established</i></p>		
		<p><i>Rationale:</i> Citizen science has been shown to provide significant leverage in observation power, accurate data (depending on experience and training in taxonomic identification) and should be encouraged as a valuable tool in the early detection of any invasive alien species in the EU.</p>							

<p>Rapid eradication for new introductions - Measures to achieve eradication <u>at an early stage of invasion</u>, after an early detection of a new occurrence (cf. Article 17). This section assumes that the species is not currently present in a Member State, or part of a Member State's territory. This table is repeated for each of the eradication measures identified.</p>	
<p>Measure name</p>	<p>Mechanical control, uprooting</p>
<p>Measure description Provide a description of the measure and its objective If relevant, include a summary of the methodology to apply the measure, with references to sources of information where detail can be found (e.g. best practices, standard operating procedures etc.).</p>	<p>Small liana plants can be hand-pulled but the entire plant needs removing including the entire root system, as the species can resprout from root fragments. For climbing vines, the vines near the ground should be cut at a comfortable height to kill upper portions and relieve the tree canopy, while trying to minimize damage to the bark of the host tree. The plant will sprout vigorously once cut, therefore rooted portions will remain alive and should be pulled, repeatedly cut to the ground, or treated with herbicide (see table below). Cutting without herbicide treatment will require repeated cutting as plants will resprout from the base (Hutchison 1992, NRCS n.d.). Monthly mowing (or if practical every 2 weeks) will eventually exhaust the plants, mowing 2-3 times a year only results in vigorous suckering (Dreyer 2003, Lynch 2011). As the species can sprout from any portion of stem or root,</p>

	all plant material needs to be bagged and removed from the site following management (Lynch 2011, IPSAWG 2019).									
<p>Scale of application At what geographic scale is the measure applied? What is the largest scale at which it has been successfully used? Please provide examples reporting areas (km² or ha) if possible.</p>	Although no specific information is published it is assumed that the application will be effective at a relatively small scale due to the effort required.									
<p>Effectiveness of the measure Is it effective in relation to its objective?</p> <p>Based on cases where the measure has been applied (ideally correctly and comprehensively), please select one of the categories of effectiveness (with an 'X'), and provide a rationale, with supporting evidence and examples of effectiveness, if possible.</p> <p>Please identify factors that are critical in determining its effectiveness.</p> <p>Please note if effectiveness is based on research only (e.g. field or experimental trials).</p>	<p><i>Effectiveness of measures</i></p>	<p><i>Effective</i></p>		<p><i>Neutral</i></p>		<p><i>Ineffective</i></p>		<p><i>Unknown or not yet applied</i></p>	X	
	<p><i>Rationale:</i> In theory this should work if an infestation comprises just 1 or a few plants. Monitoring and perseverance is needed to sustain the effort for several years to be sure the plants are truly eradicated. No published reports of the effectiveness on new populations could be found. However, repeat cutting in the second year of management was successful on single large diameter plants in dense shade, achieving a more than 90% kill in one study (Nowak & Peck 2016).</p>									
<p>Effort required e.g. Number of times, and/or period of time over which measure needs to be applied to have results achieve its objective (please indicate the units)</p>	Mechanical treatments are best implemented before the plant is in fruit, to prevent post treatment seedling establishment (Swearingen 2009 in Lynch 2011). Several years of management and monitoring is required so as to be sure no resprouting from the roots occurs.									
<p>Resources required¹ e.g. cost, staff, equipment etc. Please note the resources (and their costs if available) that are required to</p>	While there are no published data for this measure's application to the species, the resources required would need to include labour (including voluntary if possible), hand tools and mower (terrain dependant), and also a skilled individual to undertake the post management monitoring work.									

implement the measure to meet its objective.																																								
<p>Additional cost information ¹</p> <p>When not already included above, or in the species Risk Assessment.</p> <ul style="list-style-type: none"> - implementation cost for Member States - the cost of inaction - the cost-effectiveness - the socio-economic aspects <p>Include quantitative &/or qualitative data, and case studies (incl. from countries outside the EU).</p>	No additional cost information exists.																																							
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Environmental effects	Positive		Mixed		Negative	X	None		Unknown																															
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<p>Please select one of the categories of acceptability (with an 'X'), and provide a rationale, with supporting evidence and examples if possible.</p>	<p>In general mechanical control on a small scale of an IAS is acceptable for stakeholders.</p>							
<p>Level of confidence on the information provided²</p> <p>Please select one of the confidence categories along with a statement to support the category chosen. See <i>Notes</i> section at the bottom of this document.</p> <p>NOTE – this is not related to the effectiveness of the measure</p>	<p><i>Inconclusive</i></p>	<p>X</p>	<p><i>Unresolved</i></p>		<p><i>Established but incomplete</i></p>		<p><i>Well established</i></p>	
<p><i>Rationale:</i> Published reports on effective eradication of early infestations have not been found.</p>								

Rapid eradication for new introductions - Measures to achieve eradication at an early stage of invasion, after an early detection of a new occurrence (cf. Article 17). This section assumes that the species is not currently present in a Member State, or part of a Member State's territory. **This table is repeated for each of the eradication measures identified.**

Measure name	Chemical control
<p>Measure description</p> <p>Provide a description of the measure and its objective</p> <p>If relevant, include a summary of the methodology to apply the measure, with references to sources of information where detail can be found (e.g. best practices, standard operating procedures etc.).</p>	<p>Herbicides with systemic active principles, such as triclopyr and glyphosate, are effective as they are absorbed into plant tissues and carried to the roots, killing the entire plant within about a week. Basal bark application can be highly effective (Lynch, 2009).</p> <p>Chemical control is more effective if the stems are first cut (c. 5cm above ground level) by hand or mowed and herbicide is applied immediately to cut stem tissue (see Hutchison 1992, IPSAWG 2019, NRCS n.d.). Subsequent foliar application may be needed to control new seedlings (IPSAWG 2019).</p> <p>Note that EU legislation on the use of plant protection products and biocides must be respected. In addition, herbicides may only be applied in accordance with local regulations, following label instructions and by licensed herbicide applicators and operators.</p> <p>The use of a gel formulation of glyphosate applied to cut stumps has been shown to be effective (Ward & Henzell, 2003)</p>

<p>Scale of application At what geographic scale is the measure applied? What is the largest scale at which it has been successfully used? Please provide examples reporting areas (km² or ha) if possible.</p>	<p>No details of the size of actual application of the measure could be found in published sources.</p>									
<p>Effectiveness of the measure Is it effective in relation to its objective?</p> <p>Based on cases where the measure has been applied (ideally correctly and comprehensively), please select one of the categories of effectiveness (with an 'X'), and provide a rationale, with supporting evidence and examples of effectiveness, if possible.</p> <p>Please identify factors that are critical in determining its effectiveness.</p> <p>Please note if effectiveness is based on research only (e.g. field or experimental trials).</p>	<p><i>Effectiveness of measures</i></p>	<p><i>Effective</i></p>	<p>X</p>	<p><i>Neutral</i></p>		<p><i>Ineffective</i></p>		<p><i>Unknown or not yet applied</i></p>		
<p><i>Rationale:</i> Reported to be effective on the species in numerous fact sheets (see Dreyer 1994, IPSAWG 2019, NRCS n.d.).</p>										
<p>Effort required e.g. Number of times, and/or period of time over which measure needs to be applied to have results achieve its objective (please indicate the units)</p>	<p>Several years of management and monitoring is required so as to be sure no resprouting from the roots occurs.</p>									
<p>Resources required¹ e.g. cost, staff, equipment etc. Please note the resources (and their costs if available) that are required to implement the measure to meet its objective.</p>	<p>In general, herbicide application to a single or few plants will require minimal effort, but skilled (and possibly licenced) labour is needed. In addition to the herbicide chemicals, spraying and safety equipment is required.</p>									
<p>Additional cost information¹ When not already included above, or in the species Risk Assessment.</p>	<p>No additional cost information is available.</p>									

<ul style="list-style-type: none"> - implementation cost for Member States - the cost of inaction - the cost-effectiveness - the socio-economic aspects <p>Include quantitative &/or qualitative data, and case studies (incl. from countries outside the EU).</p>																																												
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Rapid eradication for new introductions - Measures to achieve eradication <u>at an early stage of invasion</u> , after an early detection of a new occurrence (cf. Article 17). This section assumes that the species is not currently present in a Member State, or part of a Member State's territory. This table is repeated for each of the eradication measures identified.	
Measure name	Integrated control
<p>Measure description Provide a description of the measure and its objective If relevant, include a summary of the methodology to apply the measure, with references to sources of information where detail can be found (e.g. best practices, standard operating procedures etc.).</p>	<p>Integrated control or integrated pest management, i.e., a program based on a combination of preventive, cultural, mechanical, biological, and chemical practices should be always considered (Swearingen 2009).</p> <p>Chemical control is more effective if the stems are first cut by hand or mowed and herbicide is applied immediately to cut stem tissue (see guidance in Hutchison 1992, IPSAWG 2019, NRCS n.d.). Timing of these applications will have an effect on effectiveness as such.</p> <p>Note that EU legislation on the use of plant protection products and biocides must be respected. In addition herbicides may only be applied in accordance with local regulations, following label instructions and by licensed herbicide applicators and operators.</p>
<p>Scale of application At what geographic scale is the measure applied? What is the largest scale at which it has been successfully used? Please provide examples reporting areas (km² or ha) if possible.</p>	<p>No details of the size of actual application of the measure could be found in published sources.</p>

<p>Effectiveness of the measure Is it effective in relation to its objective?</p> <p>Based on cases where the measure has been applied (ideally correctly and comprehensively), please select one of the categories of effectiveness (with an 'X'), and provide a rationale, with supporting evidence and examples of effectiveness, if possible.</p> <p>Please identify factors that are critical in determining its effectiveness.</p> <p>Please note if effectiveness is based on research only (e.g. field or experimental trials).</p>	<table border="1" data-bbox="640 153 1995 220"> <tr> <td data-bbox="640 153 925 220"><i>Effectiveness of measures</i></td> <td data-bbox="925 153 1133 220"><i>Effective</i></td> <td data-bbox="1133 153 1189 220" style="text-align: center;">X</td> <td data-bbox="1189 153 1377 220"><i>Neutral</i></td> <td data-bbox="1377 153 1435 220"></td> <td data-bbox="1435 153 1624 220"><i>Ineffective</i></td> <td data-bbox="1624 153 1682 220"></td> <td data-bbox="1682 153 1995 220"><i>Unknown or not yet applied</i></td> </tr> </table> <p><i>Rationale:</i> In New Zealand a combination of stem cutting with immediate application of picloram or glyphosate, followed by a foliar application of triclopyr on the regrowth proved to be effective (Williams & Timmins 2003, Ward & Henzell, 2003). The application of a picloram containing gel registered as Vigilance proved to be 100% effective on cut stem. However, a major problem is finding all the stems. Timing of management in autumn when the plants have yellow foliage may solve this visibility problem (Williams & Timmins 2003).</p> <p>Also reported to be effective in numerous fact sheets (see Dreyer 1994, IPSAWG 2019, NRCS n.d.).</p>	<i>Effectiveness of measures</i>	<i>Effective</i>	X	<i>Neutral</i>		<i>Ineffective</i>		<i>Unknown or not yet applied</i>
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<p>Effort required e.g. Number of times, and/or period of time over which measure needs to be applied to have results achieve its objective (please indicate the units)</p>	<p>Several years of management and monitoring is required, so as to be sure no resprouting from the roots occurs.</p>								
<p>Resources required¹ e.g. cost, staff, equipment etc. Please note the resources (and their costs if available) that are required to implement the measure to meet its objective.</p>	<p>See tables above for resources required for manual cutting and herbicide application.</p>								
<p>Additional cost information¹ When not already included above, or in the species Risk Assessment. - implementation cost for Member States - the cost of inaction - the cost-effectiveness - the socio-economic aspects</p>	<p>No additional cost information is available.</p>								

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<p>Management - Measures to achieve management of the species once it has become widely spread within a Member State, or part of a Member State’s territory. (cf. Article 19), i.e. not at an early stage of invasion (see Rapid eradication table above). <u>These measures can be aimed at eradication, population control or containment of a population of the species. This table is repeated for each of the management measures identified.</u></p>	
Measure name	Mechanical control aiming at preventing fruit formation
<p>Measure description Provide a description of the measure and its objective If relevant, include a summary of the methodology to apply the measure, with references to sources of information where detail can be found (e.g. best practices, standard operating procedures etc.).</p>	<p>As birds are thought to be vectors of the species including in Europe (see Gudžinskas et al. 2020), using mechanical control as described above prior to fruit formation, will prevent animal assisted dispersal and seedling establishment. The species can have prolific fruit production occurring in summer and autumn. Individuals grown from seeds in well illuminated habitats reaching the reproductive stage at approx. 10 years, whereas individuals grown from root suckers can reach reproductive stage much sooner at four years (Gudžinskas et al. 2020). However, the species generative reproduction in Europe is controversial with some evidence of lack of flowering of the species in Belgium, whereas at least at some sites in Germany the species has lots of seed production (Gudžinskas et al. 2020). This may be due to the regional differences of the gender allocation in <i>C. orbiculatus</i> populations (individuals can be dioecious, monoecious or polygamo-dioecious), which could be a result of separate introduction events from different sources (Gudžinskas et al. 2020).</p> <p>Field studies in the USA demonstrated that the species does not build up a seed bank but actually a seedling bank. Seedlings can persist for long periods awaiting opening of the canopy to accelerate growth (Ellsworth et al 2004).</p>
<p>Scale of application At what geographic scale is the measure applied? What is the largest scale at which it has been successfully used?</p>	No details of the size of actual application of the measure could be found in published sources.

Please provide examples reporting areas (km ² or ha) if possible.									
<p>Effectiveness of the measure Is it effective in relation to its objective?</p> <p>Based on cases where the measure has been applied (ideally correctly and comprehensively), please select one of the categories of effectiveness (with an 'X'), and provide a rationale, with supporting evidence and examples of effectiveness, if possible.</p> <p>Please identify factors that are critical in determining its effectiveness.</p> <p>Please note if effectiveness is based on research only (e.g. field or experimental trials).</p>	<p><i>Effectiveness of measures</i></p>	<p><i>Effective</i></p>		<p><i>Neutral</i></p>		<p><i>Ineffective</i></p>	<p>X</p>	<p><i>Unknown or not yet applied</i></p>	
<p>Effort required e.g. Number of times, and/or period of time over which measure needs to be applied to have results achieve its objective (please indicate the units)</p>	Annual management for an undetermined period of time.								
<p>Resources required¹ e.g. cost, staff, equipment etc. Please note the resources (and their costs if available) that are required to implement the measure to meet its objective.</p>	See <i>Mechanical control</i> above.								
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Environmental effects	Positive		Mixed	X	Negative		None		Unknown																										
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<p>Management - Measures to achieve management of the species once it has become widely spread within a Member State, or part of a Member State's territory. (cf. Article 19), i.e. not at an early stage of invasion (see Rapid eradication table above). <u>These measures can be aimed at eradication, population control or containment of a population of the species. This table is repeated for each of the management measures identified.</u></p>	
<p>Measure name</p>	<p>Integrated control</p>
<p>Measure description Provide a description of the measure and its objective If relevant, include a summary of the methodology to apply the measure, with references to sources of information where detail can be found (e.g. best practices, standard operating procedures etc.).</p>	<p>No single treatment provides effective, long-term control of established populations of <i>C. orbiculatus</i> (Lynch 2011). Integrated control or integrated pest management, i.e., a program based on a combination of preventive, cultural, mechanical, biological, and chemical practices should be always considered, particularly in the case of large infestations (Swearingen 2009).</p> <p>Herbicides with systemic active principles like triclopyr and glyphosate are effective as they are absorbed into plant tissues and carried to the roots, killing the entire plant within about a week. In large scale infestations a foliar spray can be effective to reduce populations (NRCS n.d.). Timing of these applications will influence the effectiveness of these treatments.</p> <p>Note that EU legislation on the use of plant protection products and biocides must be respected. In addition, herbicides may only be applied in accordance with local regulations, following label instructions and by licensed herbicide applicators and operators.</p>
<p>Scale of application At what geographic scale is the measure applied? What is the largest scale at which it has been successfully used?</p>	<p>No details of the size of actual application of the measure could be found in published sources</p>

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<p>Effort required e.g. Number of times, and/or period of time over which measure needs to be applied to have results achieve its objective (please indicate the units)</p>	<p><i>Rationale:</i> After mowing low patches of <i>C. orbiculatus</i> in spring, one month old regrowth was effectively controlled by foliar application of triclopyr, whereas glyphosate was ineffective (Dreyer 1994). In New Zealand a combination of stem cutting with immediate application of picloram or glyphosate, followed by a foliar application of triclopyr on the regrowth proved to be effective (Williams & Timmins 2003, Ward & Henzell, 2003).</p> <p>The application of a picloram containing gel registered as Vigilance® proved to be 100% effective on cut stem. However, a major problem is finding all the stems. Timing of management in autumn when the plants have yellow foliage may solve this visibility problem (Williams & Timmins 2003)</p> <p>Integrated management is reported to be effective in numerous fact sheets (Dreyer 1994, IPSAWG 2019, NRCS n.d.).</p>							
<p>Resources required¹ e.g. cost, staff, equipment etc. Please note the resources (and their costs if available) that are required to implement the measure to meet its objective.</p>	See previous sections on mechanical and chemical control.							
<p>Additional cost information¹ When not already included above, or in the species Risk Assessment. - implementation cost for Member States</p>	No additional cost information can be found.							

<ul style="list-style-type: none"> - the cost of inaction - the cost-effectiveness - the socio-economic aspects <p>Include quantitative &/or qualitative data, and case studies (incl. from countries outside the EU).</p>																																			
<p>Side effects (incl. potential) – both positive and negative i.e. positive or negative side effects of the implementation of the measure (not the IAS itself) on public health, environment including non-targeted species, etc. For example, native species non-target impacts from trapping.</p> <p>For each of the side effect types please select one of the categories (with an 'X'), and provide a rationale, with supporting evidence and examples if possible.</p> <p>NOTE – this does not refer to direct intended effects of the measure (e.g. a reduction of the IAS population, or an increase in native species)</p>	<table border="1"> <tr> <td>Environmental effects</td> <td>Positive</td> <td></td> <td>Mixed</td> <td></td> <td>Negative</td> <td>X</td> <td>None</td> <td></td> <td>Unknown</td> <td></td> </tr> <tr> <td>Social effects</td> <td>Positive</td> <td></td> <td>Mixed</td> <td></td> <td>Negative</td> <td></td> <td>None</td> <td></td> <td>Unknown</td> <td>X</td> </tr> <tr> <td>Economic effects</td> <td>Positive</td> <td></td> <td>Mixed</td> <td></td> <td>Negative</td> <td></td> <td>None</td> <td></td> <td>Unknown</td> <td>X</td> </tr> </table>	Environmental effects	Positive		Mixed		Negative	X	None		Unknown		Social effects	Positive		Mixed		Negative		None		Unknown	X	Economic effects	Positive		Mixed		Negative		None		Unknown	X	<p><i>Rationale:</i> While applying cutting or mowing and applying the herbicide to the IAS itself other plants or fauna may sustain some collateral damage. However, note that Triclopyr has little or no impacts upon grasses.</p>
Environmental effects	Positive		Mixed		Negative	X	None		Unknown																										
Social effects	Positive		Mixed		Negative		None		Unknown	X																									
Economic effects	Positive		Mixed		Negative		None		Unknown	X																									
<p>Acceptability to stakeholders e.g. impacted economic activities, animal welfare considerations, public perception, etc.</p> <p>Please select one of the categories of acceptability (with an 'X'), and provide a rationale, with supporting evidence and examples if possible.</p>	<table border="1"> <tr> <td>Acceptability to stakeholders</td> <td>Acceptable</td> <td></td> <td>Mixed</td> <td>X</td> <td>Unacceptable</td> <td></td> <td>Unknown</td> <td></td> </tr> </table>	Acceptability to stakeholders	Acceptable		Mixed	X	Unacceptable		Unknown		<p><i>Rationale:</i> Some stakeholders may be opposed to the application of chemicals in natural areas.</p>																								
Acceptability to stakeholders	Acceptable		Mixed	X	Unacceptable		Unknown																												
<p>Level of confidence on the information provided ²</p>	<table border="1"> <tr> <td>Inconclusive</td> <td>X</td> <td>Unresolved</td> <td></td> <td>Established but incomplete</td> <td></td> <td>Well established</td> <td></td> </tr> </table>	Inconclusive	X	Unresolved		Established but incomplete		Well established																											
Inconclusive	X	Unresolved		Established but incomplete		Well established																													

Please select one of the confidence categories along with a statement to support the category chosen. See *Notes* section at the bottom of this document.

NOTE – this is not related to the effectiveness of the measure

Rationale:

Detailed published reports on effective management have not been found.

Bibliography ³

See guidance section

Use format: Author, A. A., & Author, B. B. (Publication Year). Article title. *Periodical Title*, Volume(Issue), pp.-pp.

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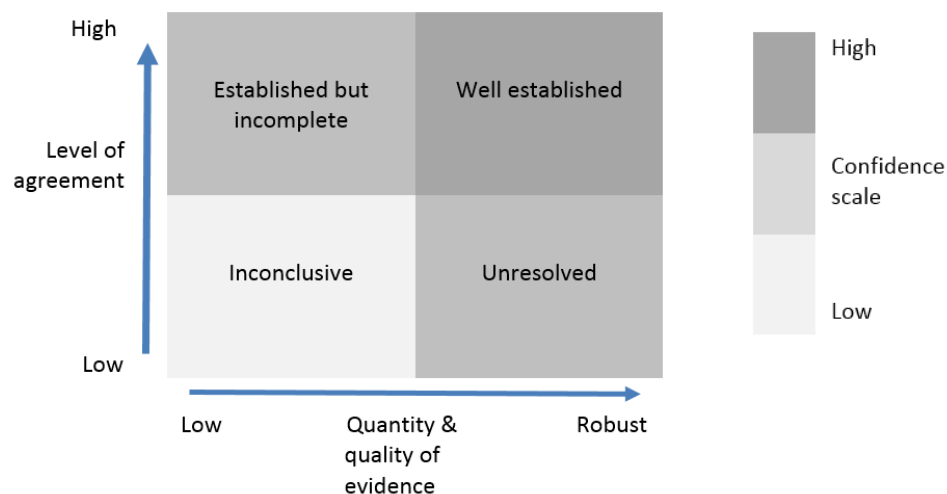
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Notes

1. Costs information. The assessment of the potential costs shall describe those costs quantitatively and/or qualitatively depending on what information is available. This can include case studies from across the Union or third countries.

2. Level of confidence¹: based on the quantity, quality and level of agreement in the evidence.



- **Well established:** comprehensive meta-analysis² or other synthesis or multiple independent studies that agree.
- **Established but incomplete:** general agreement although only a limited number of studies exist but no comprehensive synthesis and/or the studies that exist imprecisely address the question.
- **Unresolved:** multiple independent studies exist but conclusions do not agree.
- **Inconclusive:** limited evidence, recognising major knowledge gaps

3. Citations and bibliography. The APA formatting style for citing references in the text and in the bibliography is used.

e.g. Peer review papers will be written as follows:

In text citation: (Author & Author, Year)

In bibliography: Author, A. A., & Author, B. B. (Publication Year). Article title. *Periodical Title*, Volume(Issue), pp.-pp.

(see <http://www.waikato.ac.nz/library/study/referencing/styles/apa>)

¹ Assessment of confidence methodology is taken from IPBES. 2016. Guide on the production and integration of assessments from and across all scales (IPBES-4-INF-9), which is adapted from Moss and Schneider (2000).

² A statistical method for combining results from different studies which aims to identify patterns among study results, sources of disagreement among those results, or other relationships that may come to light in the context of multiple studies.