GOZDARSKI INŠTITUT SLOVENIJE

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KONČNO POROČILO O REZULTATIH OPRAVLJENEGA RAZISKOVALNEGA DELA V OKVIRU POGODBE št. 2311-05-000175 O DODATNI PROUČITVI GLIVE POVZROČITELJICE JAVOROVEGA RAKA.

Poročilo velja za obdobje od 6. 9. 2005 do 1. 12. 2005.

1) Opisno poročilo o realizaciji pogodbe:

Dodatna proučevanja glive *Eutypella parasitica*, ki povzroča javorov rak, so obsegala naslednja dela:

a. Meritve drevja z vsemi doslej najdenimi okužbami z javorovim rakom (67 okužb)
b. Izbor, odkazilo, organizacija poseka, prevoz v Laboratorij za varstvo gozdov GIS sedmih dreves gorskega javora v Tivoliju, ki so bila okužena z javorovim rakom.
c. Odkazilo, organizacija poseka, prevoz v Laboratorij za varstvo gozdov GIS gorskega javora v bližini vasi Topol pri Medvodah in treh dreves na Kozjanskem, ki so bila okužena z javorovim rakom.
d. Sekcija dreves na kolute debeline 10 cm, pridobivanje vzorcev lesa in izolacija vseh gliv iz lesa z namenom ugotoviti razširjenost glive v lesu okuženega drevesa (cca 1500 izolacij).
e. Morfološka analiza rakavih ran (velikost rakov, površina s trosišči glive, površina brez skorje, površina s pritrjeno skorjo).
f. Ocena tveganja – Pest Risk Analysis po metodologiji European and Mediterranean Plant Protection Organization (EPPO).
g. Priprava objav, ki so navedene v rubriki Doseženi rezultati, sodelovanje sodelavcev projekta na EPPO konferenci o *Phytophthora ramorum* in drugih gozdnih škodljivih organizmih (Falmouth, Velika Britanija, 5. – 7. oktobra 2005).
h. Obsežne laboratorijske raziskave pridobljenih izolatov glive – značilnosti rasti v kulturi (hitrost, oblika rasti), morfološke značilnosti glive, spremljajoče vrste gliv in njihova determinacija.

i. V pripravi sta dva znanstvena prispevka o značilnosti bolezni in njene razširjenosti v Sloveniji, ki ju ne navajamo v rubriki 4. Doseženi rezultati, ker šele zbiramo podatke in rezultate.

2) Ocena o stopnji realizacije programa in zastavljenih ciljev (samoevalvacija):

Program se je izvedel po internem načrtu del, obsega vse cilje Pogodbe.

3) Morebitne spremembe programa in njihova utemeljitev:

Jih ni.

4) Doseženi pisni rezultati so v prilogah (Priloga 1 je dodana zaradi popolnosti informacije in ni rezultat tega projekta):

Priloga 1:
Jurc D., Ogris N., 2005: Obvestilo o najdbi neobičajnih rakavih ran na gorskem javoru (*Acer pseudoplatanus*) v Tivoliju v Ljubljani in opis dela za ugotovitev povzročitelja. Tipkopis, Gozdarski inštitut Slovenije, Ljubljana, 3 str.

Priloga 2:
Jurc, D., Ogris, N., Slippers, B., Stenlid, J., 2005. First report of Eutypella canker of Maple in Europe.- New Disease Reports 11 (http://www.bspp.org.uk/ndr/july2005/2006-95.asp) – kratek znanstveni prispevek sprejet v tisk

Priloga 3:
Ogris N., JurcD., Jurc M, 2005: Javorov rak (*Eutypella parasitica*: *Ascomycota*: *Fungi*) na gorskem javorju in maklenu: značilnosti in razlike. – Gozdarski vestnik, znanstveni prispevek sprejet v tisk

Priloga 4:
Jurc D., Nikica Ogris Introduction to Eutypella canker of maple. Predstavitev na EPPO Conference on *Phytophthora ramorum* and other forest pests, Falmouth, Cornwall, GB, 2005-10-05/07

Priloga 5:
Nikica Ogris, Dušan Jurc and Maja Jurc. Spread risk of Eutypella canker of maple in Europe. Predstavitev na EPPO Conference on *Phytophthora ramorum* and other forest pests, Falmouth, Cornwall, GB, 2005-10-05/07.

Priloga 6:
Jurc D., Ogris N., Jakša J., Jurc M., 2005: Is an attempt to eradicate Eutypella canker of maple in Europe feasible? Predstavitev na EPPO Conference on *Phytophthora ramorum* and other forest pests, Falmouth, Cornwall, GB, 2005-10-05/07.

Priloga 7:
Ogris N., Jurc D., Jurc M., 2006: Spread risk of Eutypella canker of maple in Europe. EPPO Bulletin, prispevek oddan v recenzijo

Priloga 8:
Jurc D., Ogris N., 2005: Pest Risk Analysis: *Eutypella parasitica* (15. 9. 2005), 11 str.

Priloga 9:
Ogris. N., Jurc D., 2005: Ugotavljanje razširjenosti javorovega raka v Sloveniji – nadaljevanje. Metode dela. Predstavljeno na seminarju za popis razširjenosti javorovega raka v Sloveniji, Ljubljana – Tivoli, 27. 9. 2005, 30 str.

Priloga 10:

Jurc D., Ogris N., 2005. Information about the potential quarantine harmful organism. *Eutypella parasitica*, Eutypella canker of maple. Gozdarski inštitut Slovenije, Ljubljana (tipkopis), 10 str.

Priloga 11:

Jurc D., Ogris N., 2005. Podatki o potencialnem karantenskem škodljivem organizmu. *Eutypella parasitica.* Javorov rak. Gozdarski inštitut Slovenije, Ljubljana (tipkopis), 9 str.

Poročilo sestavila
Doc. dr. Dušan Jurc

Direktor Gozdarskega inštituta Slovenije
prof. dr. dr. h. c. Niko Torelli

GOZDARSKI INŠTITUT SLOVENIJE
3
Ljubljana, Večna pot 2

in Nikica Ogris

Nikica Ogris

Ljubljana 30. 11. 2005

Prejemniki:

- naročnik (Ministrstvo za kmetijstvo, gozdarstvo in prehrano)
- Gozdarska knjižnica
- Arhiv GIS

Priloga 1:

Jurc D., Ogris N., 2005: Obvestilo o najdbi neobičajnih rakavih ran na gorskem javoru (*Acer pseudoplatanus*) v Tivoliju v Ljubljani in opis dela za ugotovitev povzročitelja. Tipkopis, Gozdarski inštitut Slovenije, Ljubljana, 3 str.

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Poročevalska, diagnostična in prognostična služba za varstvo gozdov
Gozdarski inštitut Slovenije in Oddelek za gozdarstvo in obnovljive gozdne vire, BF
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Fitosanitarna uprava Republike Slovenije
Vodja sektorja za zdravstveno varstvo rastlin
ga. Vlasta Knapič
Einspielerjeva 6
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Obvestilo o najdbi neobičajnih rakavih ran na gorskem javoru (*Acer pseudoplatanus*) v Tivoliju v Ljubljani in opis dela za ugotovitev povzročitelja

Dne 9. junija 2005 smo vas z elektronsko pošto seznanili o najdbi okuženih gorskih javorov v parku Tivoli v Ljubljani in vas obvestili o naši domnevi, da bolezen povzroča gliva *Eutypella parasitica* R.W. Davidson & R.C. Lorenz (Diatrypaceae, Xylariales, Sordariomycetidae, Ascomycetes, Ascomycota, Fungi).

Sporočili ste nam, da je potrebno prve pojave neke bolezni v skladu z direktivo 2000/29 (16. člen, 1. odstavek) sporočiti Evropski Komisiji in da boste po dokončni izvedbi postopka determinacije obvestili Komisijo za karantenske organizme. Zaradi verjetne pomembnosti najdbe bomo v nadaljevanju natančno popisali vse pomembne dogodke in naše ukrepanje v zvezi z determinacijo glive ter predvideni potek dela.

Rakavo rano na gorskem javoru (*Acer pseudoplatanus* L.) smo opazili pri izvedbi terenskega pouka pri predmetu Gozdna fitopatologija za študente gozdarstva dne 25.5.2005. Okuženo drevo stoji ob pešpoti skozi gozd, v pobočju tik nad Halo Tivoli v Ljubljani. Naslednji dan sva D. Jurc in Nikica Ogris, mladi raziskovalec na GIS, na isti lokaciji in na razdalji cca. 100 m našla skupaj 5 rakavih ran. Fotografirala sva rakave rane, nabrala sva vzorce skorje s trosišči in opravila osnovne mikroskopske meritve askospor, askov in peritecijev 27.5.2005. Determinacija najdene glive ni bila mogoča po nobenem evropskem determinacijskem ključu, šele opis v knjigi Sinclair *et al.*, 1987, je omogočil začasno determinacijo kot *E. parasitica*. Pregled vse nam dostopne literature in internetnih virov je omogočil zaključek, da glive doslej niso našli v Evropi. Zato smo 27.5.2005 v Gozdarski knjižnici naročili nabavo članka, kjer je bila vrsta prvič opisana (Davidson in Lorenz, 1938) in nekaj dodatnih člankov. N.

Ogris je izoliral glivo v čisto kulturo tako, da je v sterilnih razmerah na 2% sladni agar namestil vsebino zrelih peritecijev. Opravil je izolacijo iz dveh rakavih ran. Širše območje okoli najdišča je v naslednjih dnevih (sobota 28. in nedelja 29.5.2005) večkrat pregledal N. Ogris in enkrat D. Jurc. Skupno število okužb je z novimi najdbami naraslo na 11, vendar so vse locirane v neposredni bližini prve najdbe. Pregledano je bilo širše območje Rožnika (Mostec – Hala Tivoli, Cankarjev vrh – Hala Tivoli, Študentsko naselje – Hala Tivoli).

V torek, 31.5.2005 smo obvestili g. Roberta Rodeta, odgovornega za gospodarjenje s primestnimi gozdovi na KPL Rast, o pojavu neobičajnih okužb na gorskem javoru in ga prosili za sodelovanje. Dogovorili smo se za posek okuženih javorov v avgustu ali septembru 2005 (takrat, ko bo v bližini redna sečnja) in za odvzem vzorcev (to je vseh rakavih ran), ki bodo pripeljane na GIS za podrobne analize. Obvestili smo revirno gozdarko na OE Ljubljana Natašo Strle in se dogovorili za datum označitve okuženih dreves na terenu (ta bo 14.6.2005).

V petek, 3.6.2005 smo vodji varstva gozdov na CE ZGS Joštu Jakši poslali dopis za vse gojitelje območnih enot Zavoda za gozdove Slovenije, s katerim jih prosimo za sodelovanje pri iskanju rakavih ran na celotnem območju Slovenije in za pošiljanje vzorcev, v kolikor bodo rakave rane našli (dopis prilagamo).

Zaradi neobičajno širokih askospor (po literaturnih podatkih so askospore široke 2,0-2,3 µm, askospore v vzorcih iz Tivolija pa so široke (2,0-) 2,9 (4,2) µm), smo se odločili, da bomo opravili determinacijo glive z molekularno metodo (PCR). Ker v GeneBank ni deponirana sekvenca *Eutypella parasitica*, smo v CBS naročili tipski izolat te glive, ki ga hranijo v tekočem dušiku. Naročilo so sprejeli in izolat bomo dobili v treh do štirih tednih (konec junija 2005). Primerjali bomo sekvenco ITS regije tipskega izolata in naših dveh izolatov.

V torek, 7.6.2005, smo opravili inokulacije precepljenih čistih kultur izolirane glive v skorjo mladih gorskih javorov v gozdu tik ob stavbi GIS (oba izolata v šestih ponovitvah in šest kontrol brez glive) in v petih ponovitvah v skorjo gorskega javora v laboratoriju (30 cm dolgi odrezki debelc, nameščeni v navlažen kremenčev pesek, prilagojena metoda po Elliston, 1978). S tem poskusom bomo preverili patogenost izolirane glive po Kochovih pravilih (izolacija, infekcija, reizolacija). Malo verjetno je, da bo poskus uspel v laboratoriju, saj gliva izjemno počasi prirašča v skorji javorov, poskus v naravi pa bo verjetno trajal eno ali dve leti. Za poskus v naravi smo se odločili zaradi literaturne navedbe, da gliva prične oblikovati trose na okuženi skorji po več kot štirih letih. Z našim delom (in pravočasnim uničenjem okuženih javorov) torej ni mogoče širjenje glive. Mesto inokulacije je tudi v bližini najdbe rakov na javoru v naravi.

Revirna gozdarka Nataša Strle nam je 10.6.2005 priskrbela karto Rožnika v merilu 1:5.000, na kateri bomo označevali lokacije najdenih okuženih javorov.

Načrt dela do konca leta 2005:

1) Kolikor mogoče hitro bomo izvedli dokončno determinacijo glive z molekularnimi tehnikami (po prejetju tipskega izolata). V kolikor ne bo mogoča izvedba na GIS, se bomo povezali z zunanjim laboratorijem. V kolikor bodo rezultati ustrezni (potrditev determinacije z molekularno metodo)

bomo napisali prispevek za internetno stran New Disease Reports in za objavo v reviji Plant Pathology.

2) V sodelovanju z Zavodom za gozdove Slovenije bomo intenzivirali iskanje rakavih ran na javorih. Pregled gozdov bo posebno natančen v Območni enoti ZGS Ljubljana. Opazovanja bodo opravljali revirni gozdarji ob svojem rednem delu v gozdu. V kolikor bomo dobili obvestilo o najdbi rakavih ran, bomo opravili vzorčenje. Delo bomo opravljali neprekinjeno do konca leta 2005. Z ozirom na velikost rakov in obilno oblikovanje trosišč domnevamo, da so doslej najdene okužbe stare več kot 10 let. Zato je verjetno, da je bolezen bolj razširjena, kot pa kažejo dosedanje ugotovitve.
3) Detajlno bomo analizirali morfologijo rakov (ugotovili bomo starost, prirastek, površino), simptomatiko bolezni, značilnosti trosišč v naravi in v laboratorijski kulturi. Prva opažanja kažejo na delne razlike v primerjavi s podatki iz Severne Amerike. V kolikor bomo te razlike potrdili, jih bomo opisali v prispevku za revijo Forest Pathology. Opravili bomo izolacije glive iz lesa okuženih javorov z namenom ugotoviti prisotnost glive v lesu od rakave rane proti krošnji in proti koreninam (podatek je izjemno pomemben za morebitno načrtovanje iztrebljenja glive pri nas; z okuženim lesom namreč gliva lahko ostane v gozdu).
4) Ustrezno bi bilo izvesti Pest Risk Analysis za Slovenijo (Evropo?) vendar dvomimo, da je to mogoče v okviru redne dejavnosti v projektu Poročevalska, diagnostična in prognostična služba za varstvo gozdov.

Od prve najdbe neobičajnih rakov na gorskem javoru do danes, 13.6.2005, smo celotno delo sodelavcev Laboratorija za varstvo gozdov preusmerili v pojasnitev te bolezni. O nadaljevanju dela in rezultatih vas bomo obveščali še naprej. Prosimo za kakršnekoli usmeritve, predvsem iz zakonodajnega področja, ali priporočila za delo, ki bi nam omogočile tudi formalno ustrezno ukrepanje.

Sestavila
doc. dr. Dušan Jurc

Direktor GIS
prof. dr. dr. h. c. Niko Torelli

in Nikica Ogris

Ljubljana, 13.6.2005

V vednost:
- g. Jože Falkner, Gozdarski sektor MKGP
- g. Bojan Vomer, Gozdarska inšpekcija
- g. Jošt Jakša, CE ZGS

Priloga 2:

Jurc, D. / Ogris, N. / Slippers, B. / Stenlid, J., 2005. First report of Eutypella canker of Maple in Europe.- New Disease Reports 11 (http://www.bspp.org.uk/ndr/july2005/2006-95.asp) – kratek znanstveni prispevek sprejet v tisk

First report of Eutypella canker of *Acer pseudoplatanus* in Europe

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At the end of May 2005 distinctive oval bark lesions were found on the trunks of *Acer pseudoplatanus* (sycamore) on Rožnik hill in the centre of Ljubljana, the capital of Slovenia. A characteristic feature of the cankers was that the bark remained in place except at the centre (oldest part). The cankers were located mostly on the lower portions of the trunks. Intensive surveys around Rožnik hill revealed a further 19 affected trees by the end of June. The disease was well established and the main trunks of three trees had snapped and fallen over. The furthest distance between affected trees was 10.6 km, suggesting an initial slow spread, though we do not know when the disease first appeared.

***Figure 1**: Eutypella canker on sycamore maple. Dead bark is persistent and falling off only in the oldest part of the canker; black perithecial stromata are visible.*

White to light cream coloured mycelial fans were present in the bark and were significantly more developed along the advancing edge of the lesions. Perithecia were always present on the older parts of the cankers and were extensive (Fig. 1), with necks up to 5 mm long and poorly developed stroma. Ascospores measured 8.5 (5.5-12) × 3 (2-4) µm, asci 85.5 (61-117) × 7.5 (5-10) µm (Fig. 2A), and conidia 25 (12.5-35) × 2 (1-2.5) µm (Fig. 2B). We identified this fungus as *Eutypella parasitica*. Although the range of sizes was slightly different to those given by Davidson and Lorenz (1938), all other morphological characteristics (Fig. 3) agreed with the original description. The rDNA ITS region of two isolates were sequenced (GenBank accession numbers DQ118964, DQ118965) and compared with the ex-type isolate of *E. parasitica* (CBS No 210.39, GenBank accession number DQ118966). All three sequences were identical.

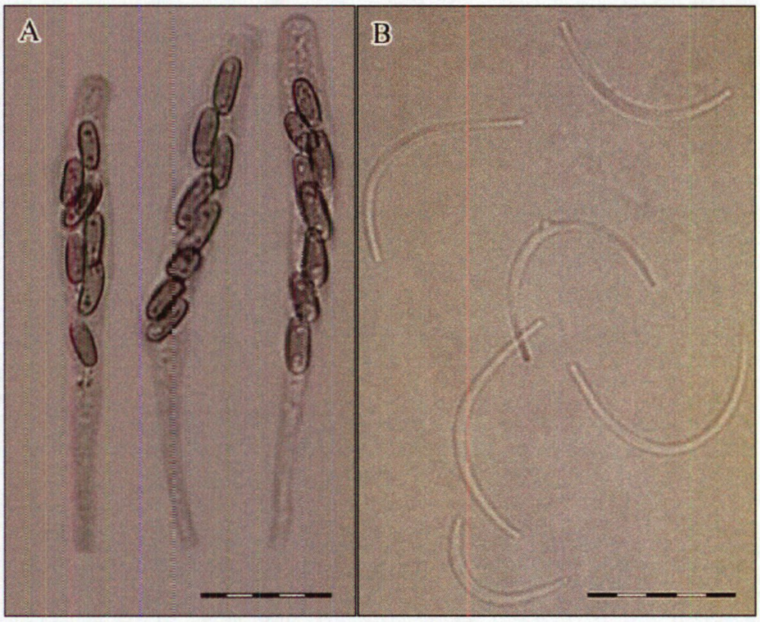

***Figure 2**: Asci with ascospores (A), conidia from culture (B) (bar = 20 µm)*

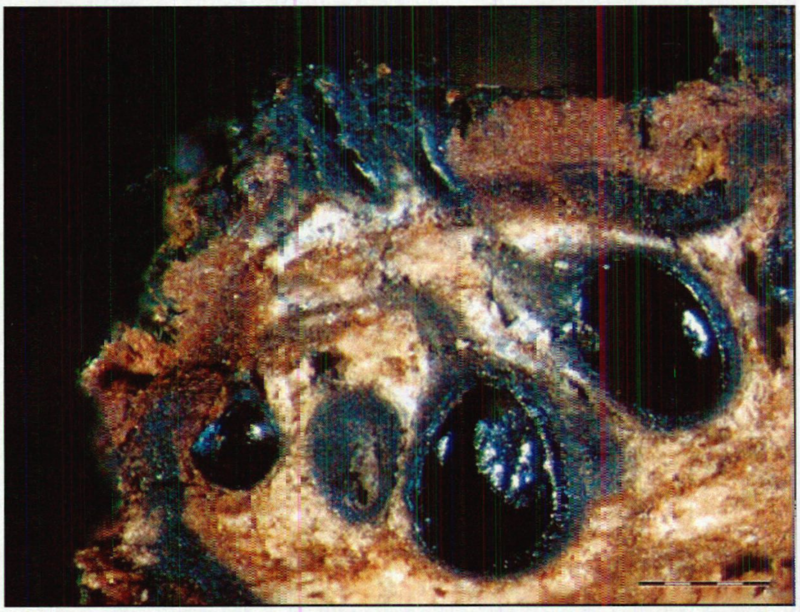

Figure 3: *Perithecia and stroma (bar = 0.5 mm)*

In June 2005 we inoculated trunks of sycamore with two isolates of *E. parasitica*. After 40 days, control wounds without the fungus had begun to heal while inoculated wounds showed some advancing necrosis. We were unable to reisolate the fungus. Disease development is slow, however, and up to two years are needed to obtain positive results (French, 1969). We will continue to monitor our trials but have no doubt that the symptoms observed are due to *E. parasitica*.

Eutypella canker of *Acer* spp. (maples) is a destructive disease found until now only in North America. Sycamore and other *Acer* spp. are widespread in Europe and this first report from Slovenia is therefore of immediate concern.

Acknowledgements

We wish to thank Dr Eric Boa (CABI Bioscience Egham) for his editorial suggestions and changes.

References

Davidson RW, Lorenz RC, 1938. Species of *Eutypella* and *Schizoxylon* associated with cankers of maple. *Phytopathology* **28**: 733-745

French WJ, 1969. *Eutypella* canker on *Acer* in New York. New York State College of Forestry Technical Publication 94. State University of New York, College of Environmental Science and Forestry, Syracuse. 56 pp

Priloga 3:

Ogris N./ JurcD. / Jurc M, 2005: Javorov rak (*Eutypella parasitica*: *Ascomycota*: *Fungi*) na gorskem javorju in maklenu: značilnosti in razlike. – Gozdarski vestnik, znanstveni prispevek sprejet v tisk

Znanstvena razprava

Javorov rak (*Eutypella parasitica*: *Ascomycota*: *Fungi*) na gorskem javorju in maklenu: značilnosti in razlike

Eutypella canker (Eutypella parasitica: Ascomycota: Fungi) on sycamore maple and field maple: characteristics and differences

Nikica OGRIS[1], Dušan JURC[2], Maja JURC[3]

Izvleček:
Ogris, N., Jurc, D., Jurc, M.: Javorov rak (*Eutypella parasitica*: *Ascomycota*: *Fungi*) na gorskem javorju in maklenu: značilnosti in razlike. Gozdarski vestnik, 63/2005, št. 10. V slovenščini, z izvlečkom v angleščini, cit. lit. 10. Prevod v angleščino: avtorji. Lektura angleškega besedila: Jana Oštir.
V prispevku opisujemo javorov rak, morfološke značilnosti bolezni na gorskem javoru in maklenu in razlike med njima. Bolezen povzroča parazitska gliva *Eutypella parasitica*. Javorov rak je gospodarsko pomembna bolezen več vrst javorov v Severni Ameriki, kjer je razširjen v okolici Velikih jezer v ZDA in Kanadi. V Evropi je bil javorov rak prvič najden v Sloveniji na gorskem javoru. V prispevku je maklen (*Acer campestre* L.) prvič ugotovljen kot nov gostitelj glive. Morfološke značilnosti bolezni so pri obeh gostiteljih zelo podobne. Po mikroskopskih lastnostih se gliva na obeh gostiteljih ne razlikuje. Slovenija kot država in njeno gozdarstvo kot stroka nosita odgovornost za izkoreninjenje ali vsaj upočasnitev širjenja bolezni po naravnem arealu javorov, ki zajema skoraj celo Evropo.
Ključne besede: javorov rak, *Eutypella parasitica*, morfologija, javor, maklen, gorski javor, *Acer* spp., *Acer campestre*, *Acer pseudoplatanus*

Abstract:
Ogris, N., Jurc, D., Jurc, M.: Eutypella canker (*Eutypella parasitica*: *Ascomycota*: *Fungi*) on sycamore maple and field maple: characteristics and differences. Gozdarski vestnik, Vol. 63/2005, No. 10. In Slovene, with abstract in English, lit. quot. 10. Translated into English by the authors. English language editing by Jana Oštir.
Eutypella canker of maple is described, morphological characteristics of the disease on sycamore and field maple and the differences between the disease on the two hosts are treated. The disease is provoked by the parasitic fungus *Eutypella parasitica*. Eutypella canker is an economically important disease of several maple species in North America, where it is spread mostly in the surroundings of the Great Lakes in the USA and Canada. In Europe it was first found in Slovenia on sycamore maple. In this contribution field maple (*Acer campestre* L.) is reported as a new host for the fungus. The morphological characteristics of the disease on the two different hosts are very similar. The microscopic properties are the same. Slovenia as a country and its forestry profession hold the responsibility to eradicate or at least slow down the spread of the disease in the natural area of maples, which comprises most of Europe.
Keywords: Eutypella canker, *Eutypella parasitica*, morphology, maple, field maple, sycamore maple, *Acer* spp., *Acer campestre*, *Acer pseudoplatanus*

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1 UVOD
INTRODUCTION

Javorov rak povzroča gliva *Eutypella parasitica*, ki sta jo opisala Davidson in Lorenz (1938). Naravni areal bolezni je Severna Amerika. V Združenih državah Amerike je javorov rak razširjen v državah v okolici Velikih jezer, to so: Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York State, Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island in Vermont (DAVIDSON / LORENZ 1938, FRENCH 1969, KLIEJUNAS / KUNTZ 1972, KLIEJUNAS / KUNTZ 1974, SINCLAIR *et al.* 1989). V Kanadi je javorov rak razširjen v pokrajinah Ontario in Quebec (KLIEJUNAS / KUNTZ 1974).

Gliva *Eutypella parasitica* povzroča rakave rane na javorih (*Acer* spp.), v Ameriki predvsem na sladkornem javorju (*Acer saccharum* Marsh.) in rdečem javorju (*A. rubrum* L.). Redkeje okuži ameriški javor (*A. negundo* L.), ostrolistni javor (*A. platanoides* L.), srebrni javor (*A. saccharinum* L.), črni javor (*A. nigrum* Mich.), gorski javor (*A. pseudoplatanus* L.) in pensilvanijski javor (*A. pennsylvanicum* L.) (DAVIDSON / LORENZ 1938, KLIEJUNAS / KUNTZ 1972, KLIEJUNAS / KUNTZ 1974).

Prvo najdbo javorovega raka v Sloveniji in hkrati prvo v Evropi smo zabeležili konec maja 2005 (JURC *et al.* 2005). S pomočjo Zavoda za gozdove Slovenije smo v času enega meseca po prvi najdbi našli le 19 dreves, okuženih s to boleznijo. Vsa poškodovana drevesa so bili gorski javori, 18 dreves se je nahajalo na Rožniku v Ljubljani in 1 drevo blizu vasi Topol pri Medvodah. Vsi raki so bili zelo stari in tri drevesa so bila že prelomljena zaradi vpliva bolezni. Razdalja med dvema najbolj oddaljenima okužbama je bila 10,6 km, kar nakazuje počasno napredovanje bolezni.

V sredini julija 2005 smo na Rožniku in na Šmarni gori prvič našli javorov rak na maklenu (*Acer campestre* L.), kar je pomenilo najdbo novega, doslej nepoznanega gostitelja javorovega raka. V tem prispevku obravnavamo podobnosti in razlike v obliki in zgradbi javorovega raka na gorskem javorju in maklenu.

2 JAVOROV RAK NA GORSKEM JAVORJU
EUTYPELLA CANKER ON SYCAMORE MAPLE

V začetni fazi bolezni okužena skorja odmre, se rahlo ugrezne, barva odmrle skorje postane temnejša, rahlo porjavi in na robu nekroze nastane neizrazita kalusna nabreklina. Zaradi počasnega napredovanja glive v skorji je prvih nekaj let okužba slabo opazna (slika 1). Nekroza se povečuje skupaj z rastjo drevesa in nastane tipična rakava rana. V skorji v centralnem delu raka se pričnejo oblikovati peritecji po petih do osmih letih od okužbe. Na površini skorje opazimo temne predele s črnimi vratovi peritecijev. Ti so dolgi do nekaj milimetrov in izraščajo iz skorje v velikem številu (slika 2). Pogosto so združeni v skupine od 10 do 40, vendar so skupine tudi mnogo večje in neprekinjeno prekrivajo obsežno površino odmrle skorje. Med kamricami peritecijev v skorji in površino skorje se oblikuje črn, gost preplet hif, ki ga imenujemo stroma in ga na prerezu skorje opazimo kot tanko črno plast.

Slika 1: Začetna okužba z javorovim rakom. Skorja se je rahlo uleknila, spremenila barvo, rob rane je rahlo dvignjen.
Figure 1: Initial infection with Eutypella canker. Bark is slightly depressed, its colour has changed, edge of the wound is only slightly raised

Slika 2: Po 5. do 8. letih po odmrtju skorje opazimo na raku številne črne vratove peritecijev. V sredini rane je ostanek odmrle veje, skozi katero je gliva verjetno okužila drevo
Figure 2: After 5 to 8 years from die-back of the bark numerous perithecial necks are visible on the surface of canker wound. In the centre of the wound is a branch stub through which the fungus presumably infected the tree

Posamezne skupine vratov peritecijev so med seboj lahko ločene z razpokami v skorji. Včasih razporeditev vratov peritecijev na skorji nakazuje letni prirast glive v skorji. Takrat so vratovi peritecijev razporejeni v elipsastih trakovih, ki so široki en do dva centimetra (slika 3). Periteciji nastajajo v skorji neprestano, stari odmirajo in med njimi se razvijajo novi. Med vratovi peritecijev na površini raka nastaja črna, stromatična plast. Ta se s starostjo dviguje nad površino skorje in nastajajo obsežne, rahlo dvignjene črne izbokline, iz katerih izraščajo črni vratovi peritecijev. Tudi ti se s starostjo podaljšujejo in rahlo debelijo.

Pomembna razlika od drugih rakavih bolezni je, da odmrla skorja zelo dolgo ostane pritrjena na rakavi rani. Vzrok za ta pojav je močan preplet hif, ki je razraščen v kambialni plasti odmrlega dela debla, v skorji in v lesu. Ta hifni preplet pritrjuje odmrlo skorjo na les in le-ta zato ne odpade. Po več desetletjih pa se periteciji in strome ne oblikujejo več, v skorji in lesu se naseljujejo številne druge glive v sukcesiji, tudi številni ksilofagi, predvsem hrošči, se naseljujejo v rano. Ti organizmi razkrajajo in drobijo skorjo in skorja prične odpadati na najstarejšem delu v sredini raka. Takrat je običajno deblo že delno deformirano ali ukrivljeno. Stare rakave rane popolnoma iznakazijo deblo (slika 4), v izpostavljen les se lahko naselijo različne glive, ki povzročajo trohnobo lesa in lahko na odprti rakavi rani oblikujejo trosnjake.

Slika 3: Skorja odpada na najstarejšem delu okužbe, vratovi peritecijev so koncentrično razporejeni na veliki površini raka
Figure 3: The bark is falling off from the oldest part of infection, perithecial necks are concentrically arranged on large surface of the canker

Slika 4: Močno iznakaženo deblo s starim javorovim rakom, v izpostavljen les so se naselile še druge glive razkrojevalke lesa
Figure 4: Considerably deformed trunk with an old Eutypella canker, other wood degrading fungi also colonized the exposed wood

Slika 5: Pahljačice podgobja v okuženi skorji so bele do krem barve
Figure 5: Mycelial fans in the infected bark are white to cream coloured

Slika 6: Strome s peritециji se lahko oblikujejo tudi na lesu
Figure 6: Stromata with perithecia can form also on exposed wood

Značilni znak okužbe z *E. parasitica* je obsežen hifni preplet v skorji rakave rane in še posebej na njenem robu, ki je v obliki tankih micelijskih pahljačic bele do rahlo krem barve (slika 5). Te pahljačice se razvijejo v okuženi skorji dve leti po nastanku okužbe (LACHANCE / KUNTZ 1966). Na drevesu je običajno ena rakava rana, najpogosteje je locirana na spodnjem delu debla, to je navadno do višine 3,7 m nad tlemi, ki predstavlja najvrednejši sortiment debla (KLIEJUNAS / KUNTZ 1974). Na okuženem lesu brez skorje se lahko oblikujejo strome s periteciji, vendar je to redko (slika 6) (KLIEJUNAS / KUNTZ 1974, DAVIDSON / LORENZ 1938).

S prostimi očmi torej vidimo na odmrli skorji črne predele rakave rane, ki se od blizu kažejo kot črne izboklinice. To so vratovi peritecijev, ki množično poganjajo iz površine odmrle skorje. Periteciji se razvijejo v skorji in imajo premer 0,6-1,0 mm, vratovi so dolgi do 5 mm. Dolžina vratov je odvisna od globine nastanka peritecija v skorji. V peritecijih se oblikujejo aski. Aski so majhni, s podaljšanim spodnjim delom (stipa), ki meri 10-40 × 1,5 µm in širšim zgornjim delom z askosporami, ki meri 32-40 × 6-7 µm. Askospore so nepravilno uni-, bi- ali multi- seriatne, enocelične, rjave, rahlo ukrivljene in merijo 8-11×2-2,3 µm (DAVIDSON / LORENZ 1938, SINCLAIR *et al.* 1989).

Poleg teleomorfa (peritecijev z aski in askosporami – spolna trosišča s trosi, ki se razvijejo po redukcijski delitvi kromosomov) oblikuje gliva *E. parasitica* tudi anamorf (konidiome s konidiji – nespolna trosišča s trosi, ki nastanejo na vegetativni način). Konidiji nastajajo v skorji v spremenljivih konidiomih, ki jih po morfologiji lahko označimo kot piknidije ali acervule. Gliva *E. parasitica* oblikuje anamorf v naravi in v čisti kulturi. Konidiomi, ki se oblikujejo v skorji, imajo lastnosti rodu *Libertella* (red *Melanconiales*) zaradi odsotnosti jasne stene piknidija in zaradi občasnega nastanka izven strome in lastnosti rodu *Cytosporina* (red *Sphaeropsidales*) zaradi plasti konidioforov, ki včasih obdajajo celotno votlino konidioma in zaradi tega, ker konidiom včasih nastane v stromi (KLEIJUNAS / KUNTZ 1972). Konidiomi se v čisti kulturi razvijejo v petih do šestih tednih in so podobni sporodohiju, so okrogli, s premerom 0,75 mm ali manj in prekriti z rumeno maso konidijev. Konidiji nastajajo v čisti kulturi holoblastično in v zaporedju na konidiogenih celicah, na katerih ostanejo vidne zažetine (angl. annelations). Nastajajo pa tudi s simpodialnim brstenjem na konidiogenih celicah, na katerih ostanejo vidne brazgotine (GLAWE 1983). Razvoj enakih konidijev v istih konidiomih na dva različna načina pri eni vrsti gliv je zelo neobičajen. Konidiji so hialini, ukrivljeni v obliki črke U, na koncih koničasti in merijo 17-32 × 1,2-1,8 µm (DAVIDSON / LORENZ 1938, SINCLAIR *et al.* 1989).

Pri nekaterih gostiteljih (npr. *Acer saccharum*) je rob stare rakave rane pogosto deformiran, ker na nekaterih predelih skorje gliva odmre. Tam drevo oblikuje kalus in kasneje obsežen ranitveni les, ki ob robu nepravilno zarašča rano. Pri sladkornem (*A. saccharum*) in rdečem javoru (*A. rubrum*) je rak močno eliptičen do podolgovat. Pri gorskem javoru (*A. pseudoplatanus*), ameriškem javoru (*A. negundo*) in ostrolistnem javoru (*A. platanoides*) je običajno rakava rana pravilna elipsa, včasih skoraj popoln krog, rob pa ni iznakažen (SINCLAIR *et al.* 1989).

3 JAVOROV RAK NA MAKLENU
EUTYPELLA CANKER ON FIELD MAPLE

Vstopno mesto za glivo, ki povzroča javorov rak, predstavlja izpostavljen ksilem (KLIEJUNAS / KUNTZ 1974). Navadno je to odlomljena veja, ki ima premer manjši od 5 cm (FRENCH 1969) (slika 7) ali pa rana na deblu (slika 8). Črni vratovi peritecijev se pri maklenu navadno najprej pokažejo med razpokami v skorji. Na ploščicah skorje se pojavijo kasneje. Trosišča se lahko pojavijo tudi na lesu (slika 8). Gliva ni samo aktivni parazit skorje, ampak je tudi saprofit, kajti preživi tudi v mrtvem lesu in brez skorje na deblu, na katerem oblikuje trosišča. Gliva povzroča rjavo trohnobo lesa in je navadno dominanta gliva v lesu debla v bližini rakave rane (DAVIDSON / LORENZ 1938).

V starosti je javorov rak na maklenu pravilne elipsaste oblike (slika 9). Na robu rakave rane lahko oblikuje debel kalusni rob, ki nakazuje, da gliva v nekaterih predelih na robu rane odmre in drevo začne rano preraščati. V tem primeru, čeprav je rak že star, se oblikujejo periteciji le na osrednjem delu raka, kjer je skorja že odmrla. Če pa je skorja že odpadla, kar je pogosto pri starejših rakih, se lahko oblikujejo periteciji na obarvanem in trohnečem lesu.

Ko je okužba mlada (do 5 let), je določitev bolezni po zunanjih znakih težka. Na terenu lahko bolezen nedvoumno določimo, če je okužba stara vsaj dve leti. Kajti vsaj dve leti sta potrebni, da gliva *Eutypella parasitica* začne v skorji ali lesu oblikovati micelijske pahljačice (slika 10), ki so značilne samo za glivo, ki povzroča javorov rak. Nobena druga znana gliva na javorih ne oblikuje takšnih micelijskih pahljačic. Če sumimo na okužbo (npr. nekoliko temnejša ugreznjena skorja), z nožem na robu sumljive okužbe odstranimo skorjo in če pod skorjo ali v skorji najdemo micelijske pahljačice, je to determinacijski znak za glivo *Eutypella parasitica*. Micelijske pahljačice se lahko razraščajo v različnih globinah skorje. Zato je ustrezno, da pri iskanju podgobja glive odstranjujemo skorjo po plasteh. Kasneje, po več letih, pa so micelijske pahljačice lahko razvite tudi v odmrli kambialni plasti.

Slika 7: Mlada okužba na maklenu. Odlomljena veja je predstavljala vstopno mesto za glivo. Na osrednjem delu raka so vidna črna trosišča glive
Figure 7: Young infection on field maple. Broken branch served as entrance for the fungus. On the central part of the canker black fungal fruitbodies are seen

Slika 8: Stara okužba na maklenu. Okužba je v tem primeru potekala skozi poškodbo debla. Opaznih je veliko trosišč na lesu, med razpokami v skorji in na skorji. Opazimo tudi kalusne nabrekline in rahlo deformacijo debla. Skorja ostane dolgo pritrjena in ne odpada
Figure 8: Old infection on field maple. In this case, the infection occured through trunk wound. Numerous fungal fruitbodies developed on the wood, in bark crevices and on the bark. Wound wood is formed at the canker edge, the trunk is deformed. The bark remains attached and is not falling off

Slika 9: Javorov rak na maklenu je v starosti v obliki pravilne elipse. Tudi v tem primeru je bilo vstopno mesto za glivo odlomljena veja

Figure 9: Old Eutypella canker on field maple is in the shape of symmetrical ellipse. Branch served as entrance point for the fungus also in this case

Slika 10: Micelijske pahljačice v maklenovi skorji so specifični determinacijski znak za glivo *Eutypella parasitica*. Vidno je odmiranje tkiv skorje 1-3 mm pred podgobjem

Figure 10: Mycelial fans in the bark of field maple are specific symptom for the fungus Eutypella parasitica. The bark tissues are necrosed 1-3 mm in front of the mycelium

4 PRIMERJAVA JAVOROVEGA RAKA NA MAKLENU IN GORSKEM JAVORJU
COMPARISSON OF EUTYPELLA CANKER ON FIELD MAPLE AND SYCAMORE MAPLE

Sivorjava skorja maklena je že pri mladih osebkih vzdolžno in prečno razpokana. Pri gorskem javoru je skorja siva in je v mladosti gladka. Zaradi bolj hrapave skorje je javorov rak na maklenu težje opazen. Deblo pri maklenu je pogosto ukrivljeno in grčavo, stranske veje so debelejše in pogostejše, krošnja je nižja in celotni habitus drevesa je bolj grmast v primerjavi z gorskim javorom. Pri gorskem javoru je skorja gladka, rast je izrazito monopodialna, hitra in habitus izrazito drevesast. Zato je pri maklenu deformacija debla pogosta in v kolikor jo opazimo, to še ne pomeni sum na rak, pri gorskem javoru pa predstavlja deformirano ali ukrivljeno deblo večjo verjetnosti za sum na okužbo z javorovim rakom. Predel z deformacijo natančno pregledamo in potrdimo sum z najdbo specifičnih simptomov: micelijske pahljačice v skorji, vratovi peritecijev na površini raka, rakava rana.

Zdi se, da bolezen pri maklenu počasneje napreduje kot pri gorskem javoru. Verjetno je vzrok v tem, da ima maklen nekoliko trši les ali več inhibitornih snovi kot gorski javor, ali pa so fiziološki procesi proti razraščanju glive v skorji uspešnejši kot pri gorskem javoru. To nakazuje debel zaraščajoč se rob rakave rane na eni izmed okužb na maklenu (slika 9). Kaže, da pri maklenu ostaja skorja v sredini rakaste rane dalj časa pritrjena na drevo kot pri gorskem javoru. Prirastne cone glive so na površini raka pri maklenu slabo opazne zaradi razpokanosti skorje.

Tudi v mikroskopskem pogledu sta javorov rak na maklenu in gorskem javorju zelo podobna, t.j. skoraj identična v mejah biološke variabilnosti. Primerjava velikosti askospor in askov različnih osebkov glive na gorskem javoru in maklenu kaže na identičnost glive še posebej, če jih primerjamo z velikostmi, ki jih navajata avtorja opisa glive *E. parasitica* (preglednica 1). Velikost peritecijev, kamrice in vratov peritecijev iz rakov na gorskem javoru in maklenu je enaka.

Preglednica 1: Primerjava dolžin in širin askospor in askov glive *E. parasitica* iz gorskega javora in maklena (Slovenija) ter iz rdečega javora (Severna Amerika)
Table 1: Comparison of lengths and widths of ascospores and asci of the fungus *E. parasitica* from sycamore maple and field maple (Slovenia) and from red maple (North America)

	Askospore		Aski	
	Dolžina (μm)	Širina (μm)	Dolžina (μm)	Širina (μm)
Gorski javor (*A. pseudoplatanus*)	(5,5-) 8,5 (-12)	(2-) 3 (-4)	(61-) 85,5 (-117)	(5-) 7,5 (-10)
Maklen (*A. campestre*)	(6,5-) 9 (-12)	(2-) 3 (-3,5)	(75,5) 90,5 (-106,5)	(6,5-) 7 (-8)
Rdeči javor (*A. rubrum*) (DAVIDSON / LORENZ 1938)	8 - 11	2 - 2.3	42 - 80	6 - 7

5 RAZPRAVA IN ZAKLJUČKI
DISCUSSION AND SUMMARY

Morfološke značilnosti javorovega raka na gorskem javorju in javorovega raka na maklenu so si nadvse podobne. Pri obeh vrstah javora je rak pravilne elipsaste oblike, okužba nastane na enak način vendar izgled rakavih ran nakazuje, da se nekroza pri maklenu širi nekoliko počasneje. Pri obeh vrstah javora najdemo pod okuženo skorjo micelijske pahljačice, gliva najprej oblikuje trosišča na najstarejšem delu raka, bolezen povzroča deformacijo debla.

Javorov rak se v Severni Ameriki na splošno pojavlja na majhnem številu javorov v sestojih (pod 5 %), vendar pa se v nekaterih sestojih nahaja na tudi do 40 % vseh javorov (GROSS 1984). Obolela drevesa imajo povprečno prebarvanega in trohnečega 12 % skupnega volumna in 49 % prodajnega volumna, kar pomeni polovično izgubo pri prodaji lesa na trgu. To pa naredi javorov rak gospodarsko pomembno bolezen.

Javorov rak je pomemben tudi iz ekološkega in socialnega vidika. Drevesa z javorovim rakom so manj mehansko stabilna in zato dovzetnejša za vetrolome, snegolome in žledolome, zaradi česar so sestoji s primesjo javorjev manj stabilni. Javorov rak kazi estetski videz javorov, kar je pomemben dejavnik pri uporabi v parkih in drugih zelenih površinah v urbanem okolju. V Sloveniji se v parkovnih površinah pogosto sadi srebrni javor, pahljačasti javor, ameriški javor, in drugi okrasni javori.

Javori so pomembni sestavni del gozdov v Sloveniji, saj so avtohtono razširjeni skoraj po celi Sloveniji. Javorov rak lahko v Sloveniji najbolj prizadene gorski javor, ki ga je v lesni zalogi 2,4 % (7.492.000 m^3) in je slovenska 7. najpogostejša drevesna vrsta, maklen, ki ima lesno zalogo 146.000 m^3 in ostrolistni javor, ki ima lesno zalogo 121.000 m^3 po podatkih o gozdovih za leto 2004 (Zavod za gozdove Slovenije). Verjetno lahko okuži in prizadene tudi trokrpi javor, topokrpi javor in tatarski javor. Za ugotovitev dovzetnosti javorov, ki še niso znani gostitelji javorovega raka, bi bilo ustrezno opraviti inokulacije glive v njihovo skorjo in les v čim krajšem času, saj dokaz patogenosti traja v primeru javorovega raka več let.

Javorov rak se bo brez dvoma še naprej širil v Sloveniji po sestojih z javori. Tudi drevje v urbanih okoljih bo obolevalo in zaradi verjetnosti zloma okuženih dreves bo nevarno ljudem. Kolikšen bo gospodarski in ekološki vpliv bolezni na slovenske gozdove ne moremo vedeti z gotovostjo, ker ne vemo koliko glivi ustrezajo ekološke razmere pri nas in drugje v Evropi. Morda bo povprečna okuženost javorov dosegla takšno velikost, kot je v naravnem arealu glive (5 % okuženih javorov), morda bo mnogo manjša morda pa mnogo večja. Osnovno vodilo pri pojavu novo spoznanega, invazivnega organizma v novem okolju pa je njegovo izkoreninjenje prav zaradi dejstva, da so posledice naselitve nepredvidljive in lahko so zelo škodljive. Zaradi potencialne škodljivosti je potrebno izvesti natančen pregled vseh sestojev, kjer je javora največ, ugotoviti natančno razširjenost javorovega raka in na osnovi tega presoditi, ali smo še sposobni bolezen iztrebiti. V kolikor je razširjenost javorovega raka pri nas velika, potem bo bolezen postala stalna spremljevalka javorov pri nas, izločala bo podstojno mladje, na odraslem drevju bo povzročala rakave rane najvrednejšega spodnjega dela javorovih debel. Zaradi značilnosti bolezni, da se počasi razvija, da šele po več letih razvoja prične oblikovati trose za širjenje, da potrebuje zelo specifično mesto za okužbo svojega gostitelja, bo širjenje počasno, vendar neustavljivo. Z veliko gotovostjo predvidevamo, da se bo razširila skoraj po celotnem arealu občutljivih javorov v Evropi. Ker je javorov rak doslej ugotovljen le pri nas, sta Slovenija kot država in gozdarstvo kot stroka dolžna storiti vse, da se prepreči njegovo širjenje.

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Priloga 4:

Jurc D., Ogris N., 2005: Introduction to Eutypella canker of maple. Predstavitev na EPPO Conference on *Phytophthora ramorum* and other forest pests, Falmouth, Cornwall, GB, 2005-10-05/07

Introduction to Eutypella canker of maple

Dušan Jurc and Nikica Ogris
Slovenian Forestry Institute, Večna pot 2, 1000 Ljubljana, Slovenia

Presented at: EPPO Conference on *Phytophthora ramorum* and other forest pests, Falmouth, Cornwall, GB, 2005-10-05/07

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IDENTITY

Name: *Eutypella parasitica* R.W. Davidson & R.C. Lorenz (Davidson and Lorenz 1938)

Synonyms: None

Taxonomy:
Diatrypaceae,
Diatrypales,
Sordariomycetidae,
Ascomycetes,
Ascomycota,
Fungi (Kirk *et al.* 2001)

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HOST PLANTS

In the natural areal of fungus in North America, the hosts are maples (*Acer* spp.). It is most common on **sugar maple (*Acer saccharum* Marsh.)** and **red maple (*A. rubrum* L.)**.

It occurs infrequently on **boxelder (*A. negundo* L.), Norway maple (*A. platanoides* L.), silver maple (*A. saccharinum* L.), black maple (*A. nigrum* Mich.), sycamore maple (*A. pseudoplatanus* L.), and striped maple (*A. pennsylvanicum* L.)** (Kliejunas and Kurtz 1974).

In Europe (Slovenia) it occurs on **sycamore maple (*Acer pseudoplatanus*)** and **field maple (*Acer campestre* L.)** (Ogris and Jurc, 2005, in press)

RANGE

North America: USA – 14 states (Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York State, Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont)

Canada (Ontario, Quebec)

Europe: **Slovenia** (environs of Ljubljana)

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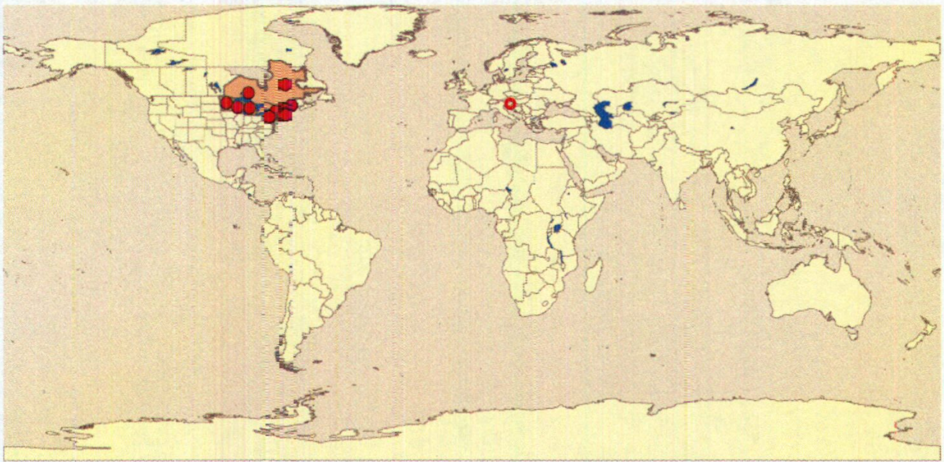
RANGE



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BIOLOGY

- Ascomata are inactive under dry conditions. When there are at least 2.5 cm of rainfall and the temperature is above 4 ^{0}C, it takes approximately two hours for fungal spores to be produced in the perithecia, which are then dispersed in groups of eight and spread by the wind as a unit.
- The greatest number of spores spread in stands at a height of 1.2 m within a radius of about 25 m from the source of the spores (old infection).

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BIOLOGY

The fungus infects trees only through exposed wood tissue, which is usually a dead branch with a diameter of up to 5 cm or a wound on the trunk that has not healed quickly.

The mycelium spreads from the stump of the branch to the trunk and creates a perennial canker on the trunk, which can then grow for decades along with the tree.

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BIOLOGY

One symptom of the disease is the slow increase in an elongated oval canker wound, which does not lose its bark due to the thick hyphal overgrowth in the bark that fixes onto the wood. The canker grows in height on average 1-2 cm per year, but usually less so in width.

Five to eight years after the bark dies off, perithecia begin to form in the poorly developed stroma.

Perithecia continually arise in the stroma and, as the old ones die, young ones are formed. Therefore spores can always be released when the temperature and moisture conditions are favorable.

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BIOLOGY

In certain hosts, conidiomata of the genera *Libertella* and *Cytosporina* will also usually develop in the stroma and between the perithecia, even conidiogenous cells produce conidia in two ways. Conidia are not germinal and therefore are not important for spreading the disease.

The fungus overgrow the wood underneath the infected part of the bark and cause brown wood rot. Decay is slow, although due to the long duration of the infection the tree often breaks at the infected area.

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BIOLOGY

When the infected trunk lies on the ground, perithecia will develop over the most of the surface of the bark and will produce spores for at least two years more

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DETECTION AND IDENTIFICATION

The infected bark dies off and sinks in slightly, the color of the dead bark becomes darker, usually slightly brownish, and at the edge of the necrosis there is a poorly defined callous swelling. Due to the slow progress of the fungus in the bark the infection is hardly noticeable for the first few years .

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DETECTION AND IDENTIFICATION

After 5 to 8 years, perithecia start to form in the central part of the canker in the poorly defined stromata. On the surface of the bark there are dark regions with black stroma and the black perithecial necks, which are a few millimeters long and grow out of the bark or stroma.

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DETECTION AND IDENTIFICATION

In some hosts (e.g. *Acer saccharum*), the edge of the canker is often deformed, because the fungus dies off in certain regions of the bark and an extensive calloused edge is formed that closes the wound irregularly.

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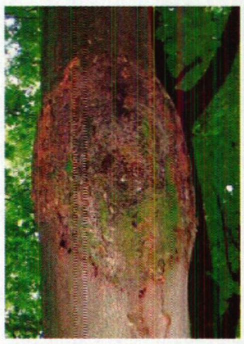
DETECTION AND IDENTIFICATION

In sycamore maple (*A. pseudoplatanus*) boxelder (*A. negundo*), and Norway maple (*A. platanoides*), the callous is usually in the form of a regular ellipse, although it can occasionally be an almost perfect circle, without a deformed edge



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DETECTION AND IDENTIFICATION

Stromata with black perithecia or black perithecia alone can cover an considerable area of the canker, they are sometimes arranged in a concentric pattern and each circle represents the yearly growth of the fungus in the bark

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DETECTION AND IDENTIFICATION

An important difference between *Eutypella parasitica* and other canker diseases is that the bark which has died off remains fixed to the canker wound for a very long time.

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DETECTION AND IDENTIFICATION

Old Eutypella cankers completely deform the trunk and various fungi can then invade the exposed wood causing wood decay and their sporophores can form on the open canker wound.

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DETECTION AND IDENTIFICATION

A characteristic sign of infection with *E. parasitica* is an extensive hyphal overgrowth in the bark of the canker wound, particularly at its edge, which forms small thin mycelial fans with a white to slightly cream color.

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DETECTION AND IDENTIFICATION

Stromata with perithecia can also form in infected wood without bark, but this is rare.

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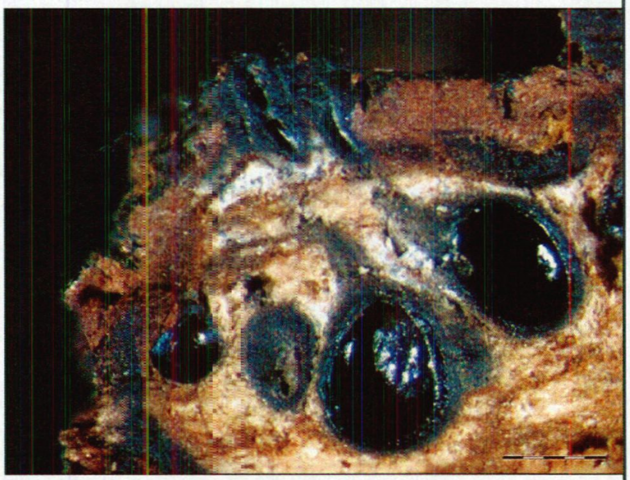
MORPHOLOGY

Perithecia have a diameter of 0.6-1.0 mm and their necks are up to 5 mm long; their length is dependent on the depth of formation of perithecia in the bark



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MORPHOLOGY

Conidia are formed in variable conidiomes, which can be designated as pycnidium or acervulus by morphology. Conidia are hyaline, bent into a U shape, pointed at the ends, and measure 17-32 × 1.2-1.8 μm

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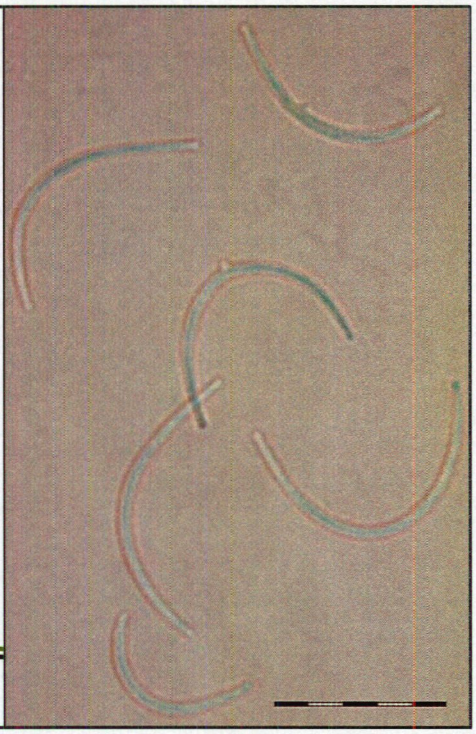

MORPHOLOGY

Asci are small with an elongated bottom part (stipe), which measures 10-40 × 1.5 μm, and a widened upper part with ascospores, which measures 32-40 × 6-7 μm. Ascospores are irregular, uni-, bi- or more seriate, one-celled, brown, slightly bent, and measure 8-11×2-2.3 μm.

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CONTROL MEASURES

Removing infected parts of the trunk from the stand is recommended in order to control the disease.

Removing branches from trees to a height of three meters is recommend for preventing infection in young trees.

In infected decorative trees, cutting out the bark around the entire edge of the canker is recommended and may halt the spread of the fungus. However, this proposal is in opposition to the finding that the fungus can grow from dead into living tissue and the success of this method has not been proved.

Poisoning the tree with Na-arsenite destroys the fungus on the edge of the canker, but does not prevent the formation of ascomata and ascospores.

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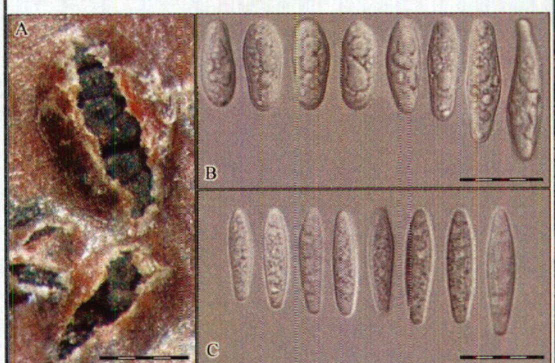
Comparison with similar species

Botryosphaeria dothidea (Moug.) Ces. & De Not. on Norway maple (*Acer platanoides*)



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Some more photographs

Thick, decayed branch as an infection point

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Some more photographs

Old infection

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Some more photographs

- Canker wounds are often covered with algae and mosses.

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Some more photographs

- Old infection

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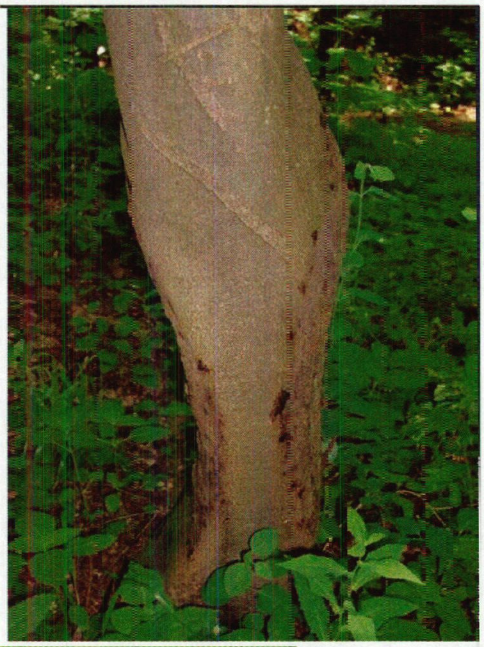
Some more photographs

Canker almost girdled the trunk.



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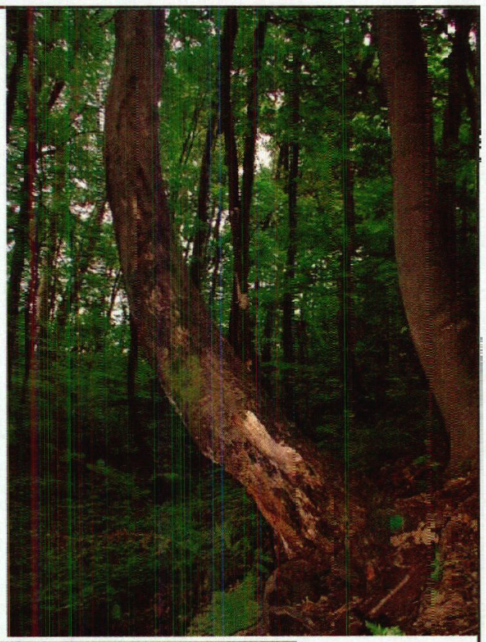
Some more photographs

In some infections the rate of canker growth is more than 1-2 cm per year – here, the height of the canker is nearly 3 m.



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Priloga 5:

Ogris N., Jurc D., Jurc M., 2005. Spread risk of Eutypella canker of maple in Europe. Predstavitev na EPPO Conference on *Phytophthora ramorum* and other forest pests, Falmouth, Cornwall, GB, 2005-10-05/07

Spread risk of Eutypella canker of maple in Europe

Nikica Ogris[1], Dušan Jurc[1] and Maja Jurc[2]

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[2] Department for Forestry and Renewable Forest Resources, Biotecnical Faculty, University of Ljubljana, Večna pot 83, 1000 Ljubljana, Slovenia

Presented at: EPPO Conference on *Phytophthora ramorum* and other forest pests, Falmouth, Cornwall, GB, 2005-10-05/07

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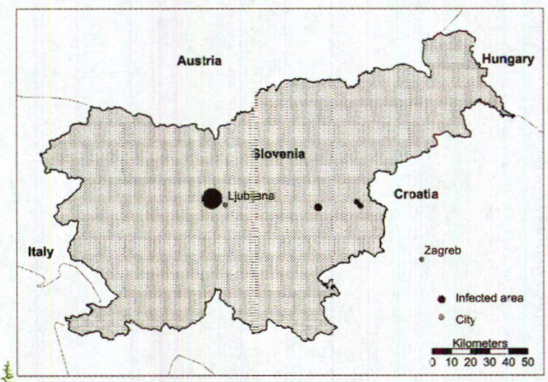
Introduction

- We present a rule-based model of *Eutypella parasitica* spread risk in Europe.



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Methods

- Four predicted variables were mapped in a GIS to generate the model of *Eutypella parasitica* establishment and spread risk.
- Spread risk is defined as a location's potential to produce inoculum and further disperse the disease to additional individual maples and locations.

Variable	Weight
Host species index	6
Precipitation	2
Temperature	2
Relative humidity	1

$$\overline{S} = \frac{\sum_i^n W_i R_{ij}}{\sum_i^n W_i}$$

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Host score

- Known susceptibility of host species to pathogen in Europe
- Size and continuity of natural distribution of host species

Host Score	Scientific name	Common name
10	*Acer pseudoplatanus*	Sycamore maple
8	*Acer platanoides*	Norway maple
5	*Acer campestre*	field maple
3	*Acer monspessulanum*	Montpelier maple
3	*Acer opalus*	Italian maple
3	*Acer tataricum*	Tatarian maple
2	*Acer cappodocicum*	Coliseum maple
2	*Acer heldreichi*	Heldreich's maple
2	*Acer hyrcanum*	Balkan maple
2	*Acer neapolitanum*	Neapolitan maple
1	*Acer lobelli*	Lobel's maple
1	*Acer sempervirens*	Cretan maple
1	*Acer velutinum*	velvet maple

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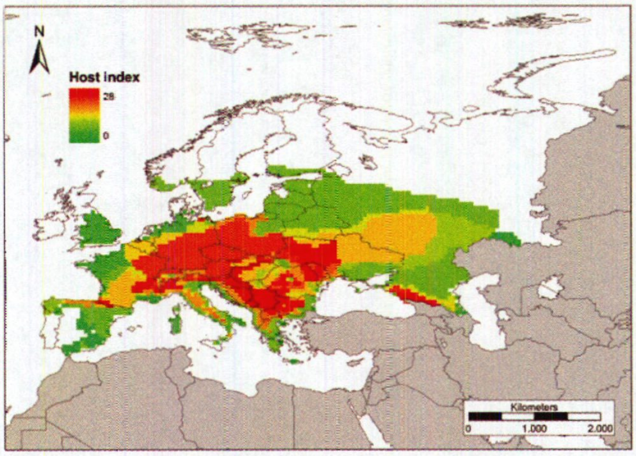
Host species index



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Temperature

- Temperatures and assigned ranks ranked 0-5 from least to most suitable for spread of the pathogen according to laboratory experiments.

Rank	Temperature (°C)
5	24-28
4	19-24; 28-30
3	14-19; 30-32
2	9-14; 32-34
1	4-9; 34-36
0	<4; >36

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Moisture variables

- Precipitation
- Relative humidity

Precipitation (mm)	Relative humidity (%)
>100	>90
80-100	85-90
60-80	80-85
40-60	75-80
20-40	70-75
<20	<70

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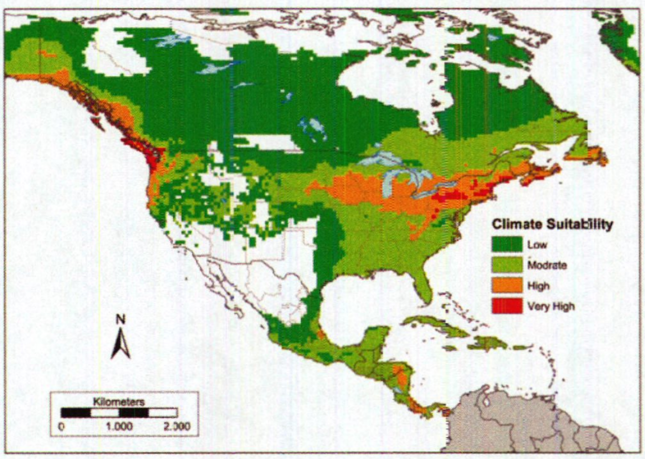
Calibration of the model



Rank	Temperature (°C)
5	24-28
4	19-24; 28-30
3	14-19; 30-32
2	9-14; 32-34
1	4-9; 34-36
0	<4; >36

↓

Rank	Temperature (°C)
5	8-9
4	7-8; 9-10
3	6-7; 10-11
2	5-6; 11-12
1	4-5; 12-13
0	<4; >13

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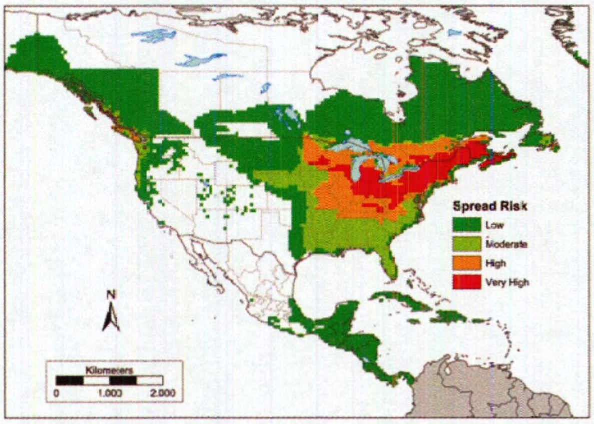
Spread risk in North America

- Calibration of the model - final



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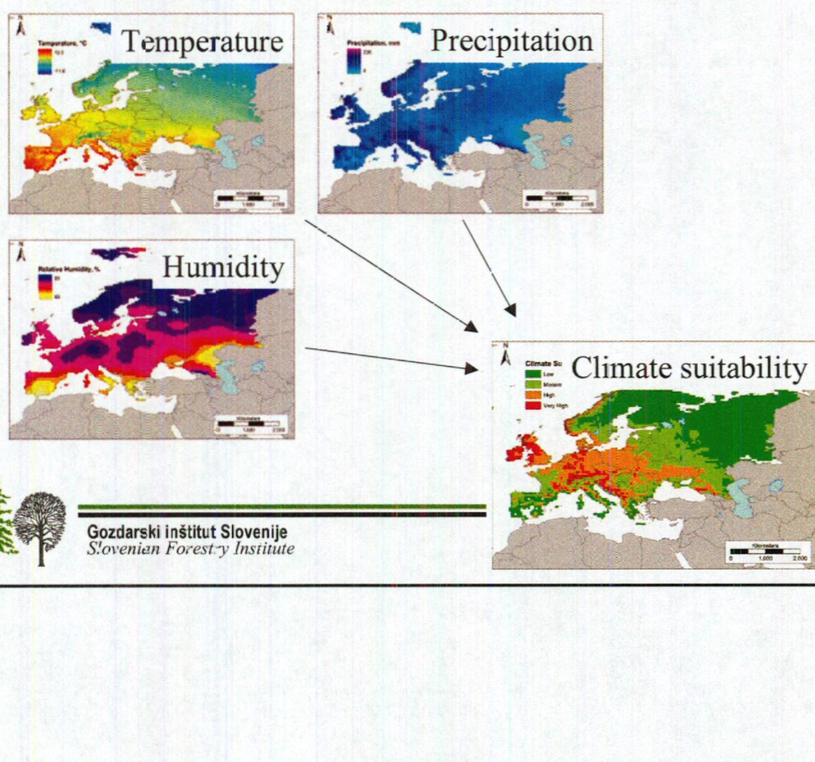
Climate suitability for Europe



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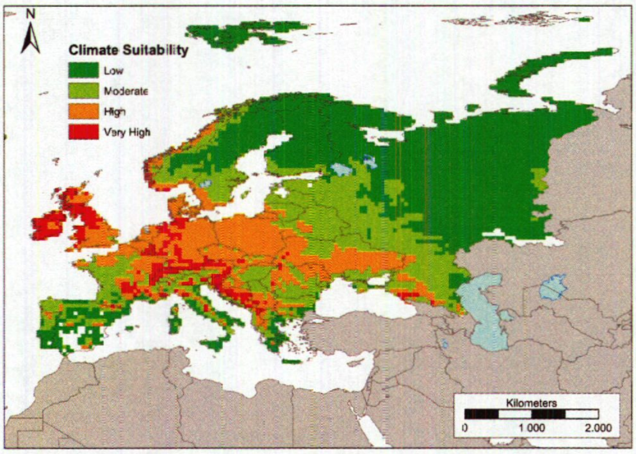
Climate suitability



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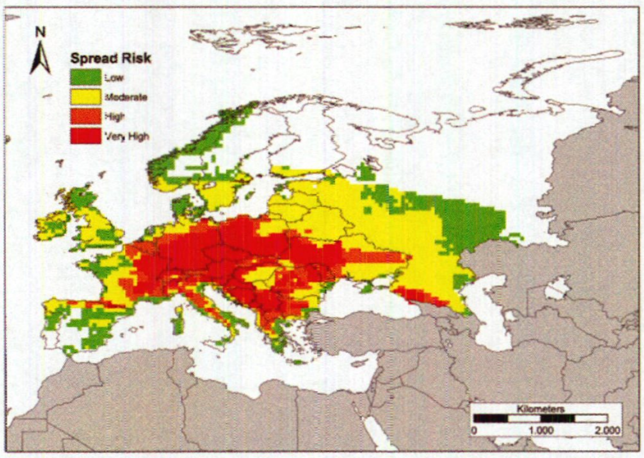
Spread risk

Spread risk	Area (km^2)	Precentage (%)
Very high	1,404,033	13
High	915,835	8
Moderate	2,875,609	26
Low	1,733,424	16



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Discussion

- The model is "good" but it could be "better"
  - abundance data of host species is missing
  - coarse scale of variables
  - variable ranges
  - other important variables?
  - average climate : specific weather

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Conclusions

- Natural spread is slow and short distance
- Long distance spread is done by humans:
  - ornamental maple species (saplings)
  - logs
- An alarming area of uninfected forests in Europe at considerable risk
- Prevent long distance spread

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Thank you for your attention!

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Priloga 6:

Jurc D., Ogris N., Jakša J., Jurc M. 2005: Is an attempt to eradicate Eutypella canker of maple in Europe feasible? Predstavitev na EPPO Conference on *Phytophthora ramorum* and other forest pests, Falmouth, Cornwall, GB, 2005-10-05/07.

Is an attempt to eradicate Eutypella canker of maple in Europe feasible?

Jurc Dušan [1], Ogris Nikica[1], Jakša Jošt[2] and Jurc Maja[3]

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[2] Slovenia Forestry Service, Večna pot 2, 1000 Ljubljana, Slovenia

[3] Department for Forestry and Renewable Forest Resources, Biotecnical Faculty, University of Ljubljana, Večna pot 83, 1000 Ljubljana, Slovenia

Presented at: EPPO Conference on *Phytophthora ramorum* and other forest pests, Falmouth, Cornwall, GB, 2005-10-05/07

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With the increased volume and speed of national and international trade, the risk of invasive species increases.

Eradication of newly introduced disease is the most desirable option, but often the most difficult to approach.

Eradication of an invasive species is extremely difficult if not impossible.

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Success of eradication depends on many conditions, most important are:

- thorough initial assessment of the situation,
- well defined area of action,
- detailed information of methods of eradication,
- training and control methods,
- commitment and involvement of cooperating staff,
- activities to secure the resources

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The report of Eutypella canker of maple (*Eutypella parasitica*) in Slovenia and its probable spread raises the question of the possibility of its eradication.

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Forests in Slovenia

Area: 1.142.869 ha (57 % of land cover)

Wood stock: 250 m³/ha

Ownership:

70% private forests

(300.000 owners)

30% state forests

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- *Acer pseudoplatanus* is the seventh most frequent tree species in Slovenia, its wood stock is 7,492,000 m^3,
- *A. campestre* wood stock is 146,000 m^3,
- *A. platanoides* wood stock is 121,000 m^3.

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- One week after the determination of the disease (June 2nd 2005), Slovenian Foresty Service was informed about the find and asked for the intensive search for the disease.
- Two seminars for district field foresters were conducted to recognise the disease, instruction for the immediate reporting of the finds was administrated.
- After confirming the determination (PCR of type strain and isolates from Slovenia) EPPO and EU were informed about the find of Eutypella canker on July 22nd 2005.

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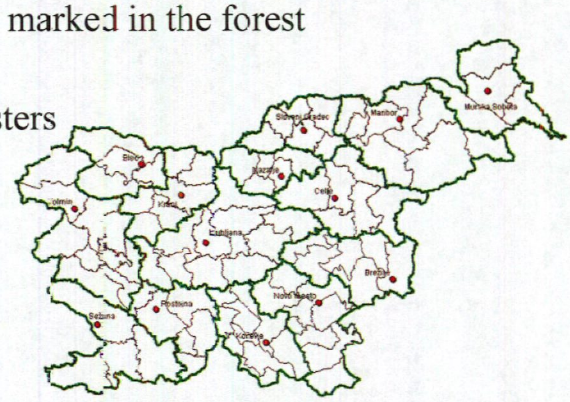
Slovenian Forestry Service

Conatural forest management is prescribed by Forest low

Every tree to be cut is marked in the forest

780 employees

400 district field foresters



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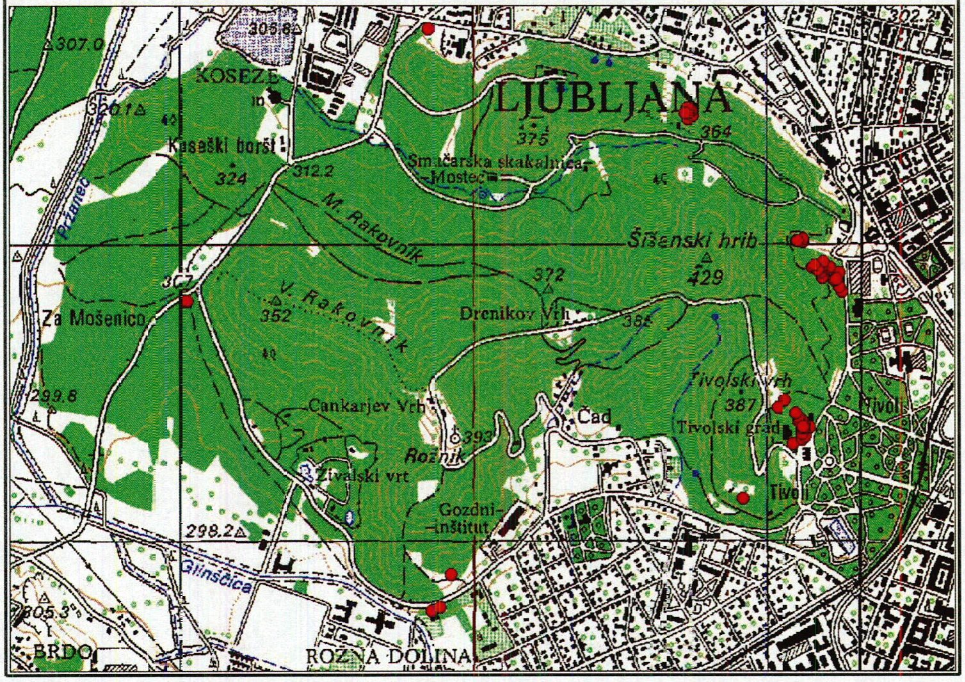
Locations of trees with Eutypella canker in Ljubljana



Priority areas for the search for Eutypella canker

- Finds of the disease from June to September 2005.

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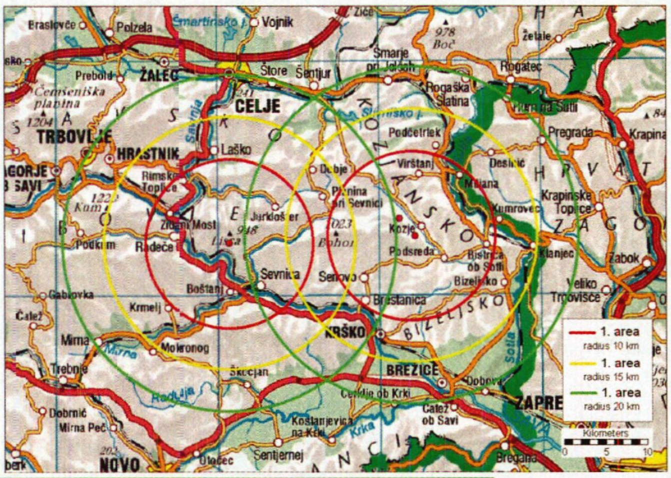
Priority areas for the search for Eutypella canker

- New finds of the disease on September 29th 2005.



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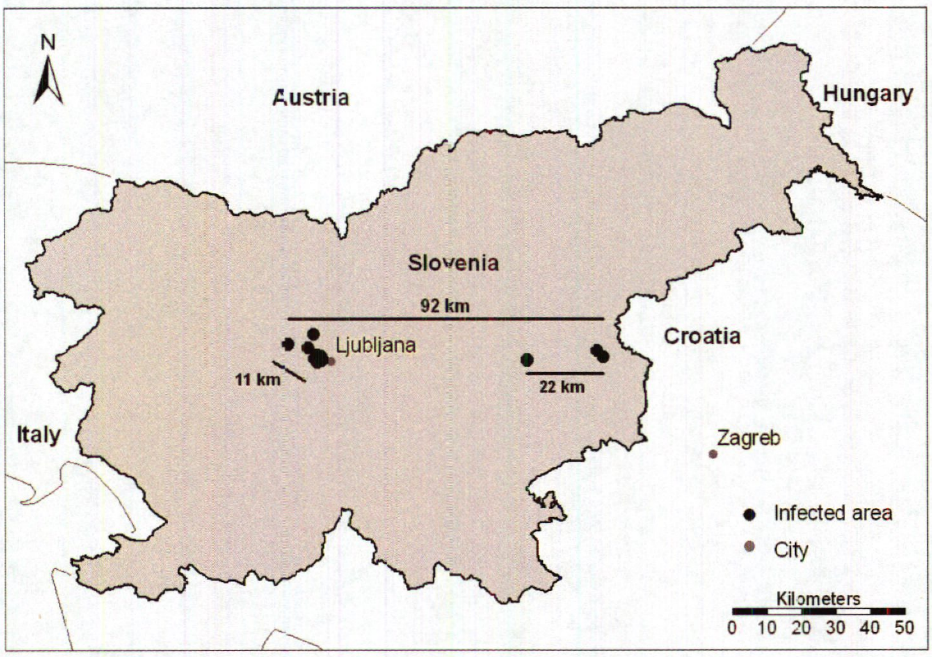

In favor of the proposal fot eradication are the following biological properties of the pathogen:

- The development and life cycle of the disease are substantially slower than in comparable canker diseases
- The fungus can infect the host only through special entry points (branches, deep wounds in sapwood)
- Ascospores are distributed only over short distances from the source (i.e. old infection)

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Against the attempt for the eradication are the following facts:

- The age of infections found in Slovenia is very high (more than 20-30 years). Thus, it is very likely that the actual spread is larger than previously established.
- Detection of the disease in the early phases of development is impossible in the field (the symptoms are not visible to the naked eye for as long as 5 years or more after the initial infection).
- Air distance between the two most distant infections is 92 km.

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If the disease is not eradicated in Slovenia then it will without a doubt eventually spread into areas with sensitive maples within Europe. Spread will be relatively slow, but certain and continuous. It could be accelerated by trade with diseased plants (saplings) or infected wood and transported to new locations within the area at risk. In this case the disease could spread from each entry point.

If the disease is not eradicated there are options for:

- containment
- control
- or mitigation

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- In any case Forestry service of Slovenia should intensify monitoring activities to establish real spread of the disease.
- Special felling teams should be established for the destroying the infected parts of the trees and for performing other sanitation measures
- Research on appropriate sanitation measures should be performed (uprooting the trees?)

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- We believe that due to the vast area of the disease spread and numerous, widespread occurrence of host trees the eradication is not possible in Slovenia.
- To control the disease it is essential to establish competent state body with high administrative and execution mandate, to organize efficient realization structure and to monitor and inspect the course of the disease suppression.

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Spread risk of Eutypella canker of maple in Europe

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Abstract

Eutypella canker of maple, caused by the pathogen *Eutypella parasitica*, has been recently reported for the first time in Europe. A rule-based model of *Eutypella parasitica* spread risk in Europe is presented. This model incorporates the effects of spatial and temporal variability of multiple variables on pathogen spread and establishment. Model predictions are based on current knowledge of host susceptibility, pathogen reproduction, and pathogen transmission, with particular regard to the host species' distribution and climate suitability. Maps of host species' distributions and monthly weather conditions were spatially analyzed in a Geographic Information System and used the magnitude and direction of each variable's effect on disease spread. Spread risk predictions were computed for each month and averaged to generate a cumulative risk map. The model was calibrated using data on the natural distribution of Eutypella canker in North America. Extensive areas covering the natural distribution of maples in Europe are at considerable risk from the *Eutypella parasitica* infection. The most endangered regions are broad areas of the Balkans, the Apennines, France, Central and Eastern Europe, and the Caucasus.

Keywords: *Eutypella parasitica*, Eutypella canker of maple, disease spread, risk modelling

1 Introduction

Eutypella canker of maple originated in North America where it was first found and described by Davidson and Lorenz (1938). The disease has been reported in states in the areas surrounding the Great Lakes: Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York State, Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, and Vermont. In Canada it has been reported in Ontario and Quebec provinces.

The hosts of *Eutypella parasitica* in North America are maples (*Acer* spp.). It is most common on sugar maple (*Acer saccharum* Marsh.) and red maple (*A. rubrum* L.). It occurs infrequently on boxelder (*A. negundo* L.), Norway maple (*A. platanoides* L.), silver maple (*A. saccharinum* L.), black maple (*A. nigrum* Mich.), sycamore maple (*A. pseudoplatanus* L.), and striped maple (*A. pennsylvanicum* L.) (Kliejunas & Kuntz, 1974).

Eutypella canker was found for the first time in Europe at the end of May 2005 (Jurc *et al.*, 2005). Distinctive bark lesions in the shape of cankers were noticed on the trunks of sycamore maple on Rožnik hill in the forest in the centre of Ljubljana, the capital of Slovenia. All of the infections found were very old and three trees had already broken due to disease impact. The Slovenian forestry service has been helping to determine the range of the diseased area. After 3 months of intensive search, 56 cases of Eutypella canker were found. The air distance between the two most distant infections was 92 km. (Fig. 1). Five cankers were found on field maple (*A. campestre*), which is a newly reported host of *Eutypella parasitica* (Ogris *et al.*, 2005).

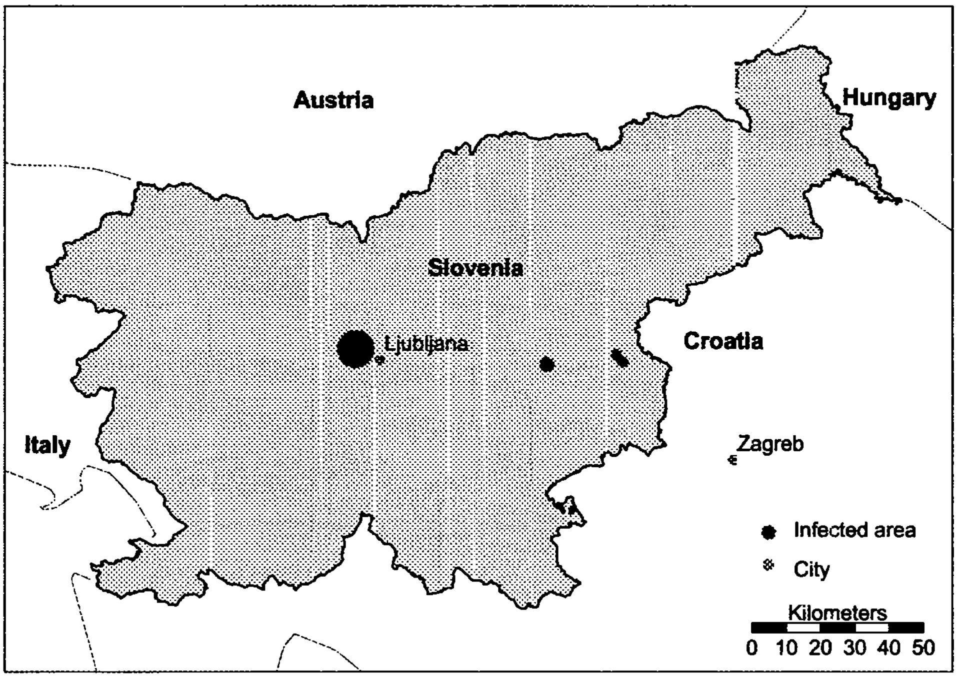

Fig. 1 Current infection range of *Eutypella parasitica* in Slovenia

Eutypella canker of maple is a destructive disease of maples originally found in North America (Sinclair *et al.*, 1989). Maples are, however, also ecologically and economically important trees in European forests. The future impact of this disease on maples in Europe is not known, but its spread risk can be predicted to a certain level of probability.

We present a rule-based model of *Eutypella parasitica* spread risk and establishment in Europe. The model incorporates the effects of spatial and temporal variability of multiple variables on pathogen spread and establishment. Model predictions are based on current knowledge of host susceptibility, pathogen reproduction, and pathogen transmission with particular regard to the host species' distribution and climate suitability. Maps of host species' distributions and monthly weather conditions were spatially analyzed in a GIS and used to calculate the magnitude and direction of each variable's effect on disease spread. Spread risk predictions were computed for each month and averaged to generate a cumulative risk map. The model was calibrated using data on the natural distribution of Eutypella canker in North America.

2 Methods

We used the model that was developed for mapping the risk of establishment and spread of sudden oak death in California as the framework for our work (Meentemeyer *et al.*, 2004). The model was fitted to *Eutypella parasitica* characteristics and its spatial distribution.

Four predicted variables were mapped in a GIS to generate a model of *Eutypella parasitica* establishment and spread risk, based on the combined effects of spatial variation in the host species and environmental conditions. The variables include a host species index, temperature, and moisture variables.

2.1 Developing the database

2.1.1 Host species data

Two datasets of host species for *Eutypella parasitica* were built. The first dataset contained the distribution of host species in North America and the second covered those in Europe. The datasets are organized in a GIS vector format. The first step in building the datasets was to find out which host species of *E. parasitica* are present in North America and Europe. Therefore, we constructed a list of maples using the data from Krüssmann (1976), Schütt *et al.* (2001), and Potočić (1983). There are 26 maple species naturally present in North America and Europe (Table 3, Table 4).

Maps of the ranges of tree species in North America compiled by Elbert Little of the U.S. Department of Agriculture, Forest Service, and others were digitized for use in the USGS (US Geological Survey) vegetation-climate modelling studies These digital map files are freely available for download from the internet (USGS, 1999). There are geographic ranges for 13 maple species. We decided to also include the Norway maple and sycamore maple because they are reported to be host species and are exotic, invasive tree species in North America. Their presence in North America is documented at NatureServe (2005) at the state and regional level and gives a more inaccurate distribution of data than Elbert Little.

Distribution ranges of maples in Europe were collected from different sources. Distribution maps for sycamore maple (Rusanen & Myking, 2003) and field maple (Nagy & Ducci, 2004), which were already in GIS vector format, were obtained from the EUFORGEN webpage. We scanned distribution maps from Schütt *et al.* (2001) for the distribution of *Acer platanoides*, *Acer monspessulanum*, *Acer sempervirens*, and *Acer opalus*. These images were then georeferenced and converted into ArcView® shapefile format for each maple species itself. For the remaining 7 maple species we scanned the distribution ranges from Potočić (1983) and put them through the process of georeferencing and making a GIS vector for each species separately. In the Europe datasets the quality of data was the best for the sycamore and field maple, while distribution ranges for other maple species seem to be less accurate.

2.1.2 Temperature and moisture

The climate data used in our model include monthly averages for precipitation, temperature, and relative humidity. Monthly averages for precipitation and temperature were obtained from the IIASA Climate Database (Leemans & Cramer, 1991). The IIASA Climate Database was created at the International Institute for Applied System Analyses by Rik Leemans and Wolfgang P. Cramer to represent current global climate. There are three variables included in the Database: average monthly cloudiness, precipitation, and temperature, with 12 monthly values per variable. These values were calculated from existing historical weather records with the common feature that most cover at least five years during the period between 1930 and 1960. The weather records from up to eight different sources were standardized, ranked in quality, selected, interpolated, and fitted to a one-half degree (0.5°) latitude / longitude terrestrial grid surface (grid cell size is approximately 55 km × 55 km); there are no values for non-land areas, since they are not important for the model.

The areas with the best data coverage are Europe, the USA, southern Canada, East Asia and Japan, while Africa and Australia have less complete coverage. High latitudes, as well as arid and mountainous zones exhibit the least coverage, especially Siberia, northern Canada, South America, China, Mongolia, and the Tibetan Plateau. Despite certain data gaps and inconsistencies, the IIASA Climate Database is considered appropriate for use at least at regional scales and above, in various applications relating to agriculture, biogeography, ecology, geography, and especially vegetation models. Therefore, the database is suited this model's requirements.

The dataset for monthly averages of relative humidity was obtained from NCEP/NCAR reanalysis data (NOAA-CIRES Climate Diagnostics Center, 2005). The NCEP/NCAR Reanalysis project uses a state-of-the-art analysis / forecast system to perform data assimilation using data from 1948 to the present. A subset of this data has been processed to create monthly means of a subset of the original data. Grid size of each grid cell is 2.5° latitude × 2.5° longitude, which is 5 times the coarse resolution than data for the monthly means of temperature and precipitation. The coarseness of the relative humidity grid was acceptable because relative humidity does not seem to be very important to the potential of pathogen spread.

2.2 Developing the model

A rule-based model was developed to predict the risk of *Eutypella parasitica* spread in forests in Europe. Spatial models of this type use research data and expert input to determine the importance of predictor variables. In our model, each predictor variable was assigned a weight of importance, and each variable's range of values was ranked to encode the magnitude and direction of its effect on spread risk (Tables 1 and 2). The equation used to run the model is simply the sum of the product of each ranked variable and its weight of importance, divided by the sum of the weights:

$$\bar{S} = \frac{\sum_i^n W_i R_{ij}}{\sum_i^n W_i}$$

where $\bar{S}$ is the spread risk for a grid cell in the model output, W_i is the weight of the ith predictor variable, and R_{ij} is the rank for the jth value of the ith variable, the rank of j depending on the variable's value at a given grid cell. Each variable's weight and subsequent ranks were based on field and laboratory studies of disease symptoms in a variety of host species. Particular attention was paid to differences in a host's ability to harbor and enable the spread of the pathogen, as well as the effect of environmental factors on pathogen survival, reproduction and transmission. In this model, "spread risk" is defined as a location's potential to produce inoculum and further dispersion of the disease to additional individual maples and locations. This model concentrates on "natural" forms of spread and does not take into account long distance human-mediated spread (e.g., transport of saplings or logs).

Risk predictions were computed for each month and the 12 monthly maps were then averaged to produce a cumulative spread risk at 4 risk levels.

Table 1 Weights (*W*) assigned to predictor variables in the *Eutypella parasitica* spread risk model, ranked 1-6 from lowest to highest importance

Variable	Weight
Host species index	6
Precipitation	2
Temperature	2
Relative humidity	1

Table 2 Range of values for predictor variables and assigned ranks (*R*) in the *Eutypella parasitica* spread risk model, ranked 0-5 from least to most suitable for spread of the pathogen

Rank	Host species index		Precipitation	Temperature	Relative humidity
	North America	Europe	(mm)	(°C)	(%)
5	24-29	23-28	>100	8-9	>90
4	18-24	18-23	80-100	7-8; 9-10	85-90
3	12-18	12-18	60-80	6-7; 10-11	80-85
2	6-12	6-12	40-60	5-6; 11-12	75-80
1	1-6	1-6	20-40	4-5; 12-13	70-75
0	-	-	<20	<4; >13	<70

2.2.1 Scoring the host index

Each host species is scored from 0 to 10 based on its potential to produce inoculum. In Table 3, host scores for North America are presented and in Table 4 host scores for Europe are presented. The host index is calculated in the GIS by summing each host's potential spread score in a given grid cell (Fig. 2). The range of values (0-28 for Europe and 0-29 for North America) is linearly rescaled from 0 to 5, low to high spread potential, to rank (*R*) variable (Table 2). The host species index variable is assigned an importance weight (*W*) of 6, the highest possible weight (Table 1).

Sugar maple (*Acer saccharum*) was assigned the highest potential spread score (10) among the hosts in North America because the disease was reported to be most severe in this species (Davidson & Lorenz, 1938; Kliejunas & Kuntz, 1974; French, 1969). Red maple (*Acer rubrum*) also scored very high (8) because Eutypella canker was reported to be a common cause of perennial canker in this species (Kliejunas & Kuntz, 1974). Boxelder (*Acer negundo*) scored moderately high (5) because the fungus has frequently been collected from this species and it occurs over a wide area (French, 1969). Norway maple (*Acer platanoides*) was assigned a score of 3 because Eutypella canker is commonly found on this species in landscapes but not in forests (Sinclair *et al.*, 1989). Black maple (*Acer nigrum*) also received a score of 3 as it has Eutypella canker relatively frequently (French, 1969) Sycamore maple (*Acer pseudoplatanus*) and silver maple (*Acer saccharinum*) were assigned a very low score of 2 because there were only single reports of canker in these species in North America (French, 1969). Bigleaf maple (*Acer macrophyllum*) was assigned a score of 1 because there was only a single report of Eutypella canker in this species (French, 1969). Striped maple (*Acer pensylvanicum*) was also assigned the lowest score of 1 because there have been no reports of the pathogen in this species, although experimental inoculation has shown that it is susceptible (Sinclair *et al.*, 1989). All other species of maple in North America were assigned a spread potential score of zero because there have been no reports showing susceptibility to the pathogen.

Host species (*Acer* spp.) naturally distributed in Europe were scored in a somewhat different manner than in North America where host species were scored according to knowledge of their susceptibility to the *Eutypella parasitica* and the known frequency of Eutypella canker distribution on these species. For North America scoring of host species was made for need of calibrating the model while for Europe scoring was made for need of disease spread modelling. Scoring of host species for Europe was made according to the following criteria: known susceptibility of host species to the pathogen in Europe, as well as the size and continuity of the natural distribution of the host species. Sycamore maple (*Acer pseudoplatanus*) was assigned the highest potential spread score among the hosts in Europe because the majority of Eutypella cankers have been found on this species (Jurc *et al.*, 2005). Norway maple (*Acer platanoides*) was assigned a high score of 8 because its natural distribution covers a wide area and is continuous; furthermore, it is already known to be a host species to the pathogen in North America. Field maple (*Acer campestre*) received a moderate score because it has already been reported as a host species, around 10 % of known Eutypella cankers in Europe are found on field maple (Ogris *et al.*, 2005), and the geographic range of field maple covers a wide area. All other species of maple naturally present in Europe have not yet been identified as host species but we scored them from 1 to 3 according to size of their natural distribution area and their overlapping with sycamore maple, Norway maple, and field maple.

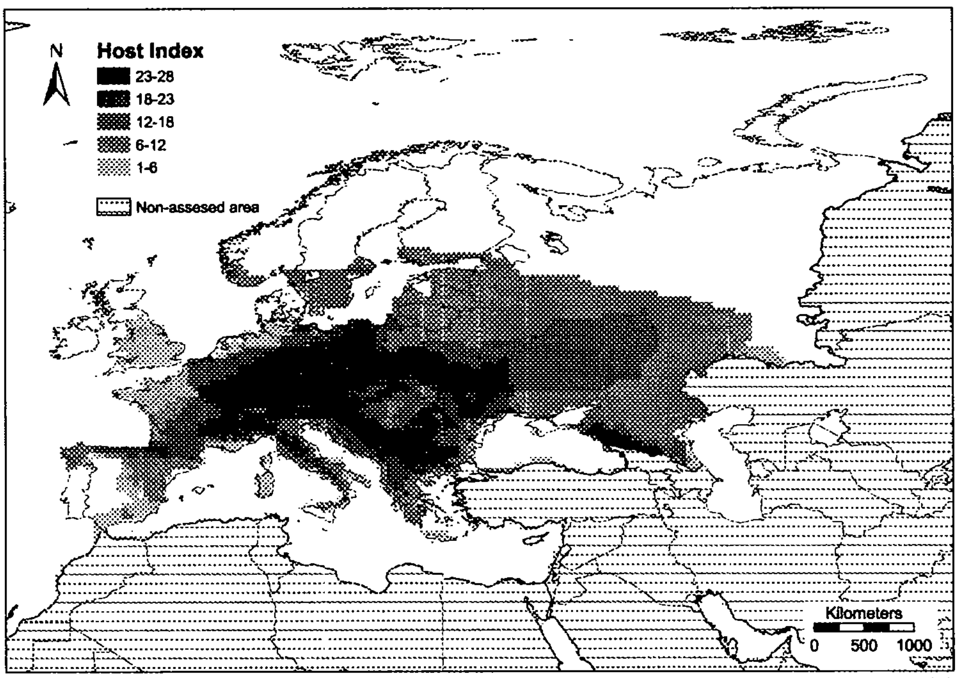

Fig. 2 Host species index; values from 1 to 28 are progressively assigned into 5 ranks

Table 3 Scores assigned to host species, ranked from 1 to 10 from lowest to highest potential to spread inoculum of *Eutypella parasitica* in its natural distribution in North America

Host Score	Scientific name	Common name
10	*Acer saccharum* Marsh.	sugar maple
8	*A. rubrum* L.	red maple
5	*A. negundo* L.	Boxelder
3	*A. nigrum* Michx. f.	black maple
3	*A platanoides* L.	Norway maple
2	*A. saccharinum* L.	silver maple
2	*A. pseudoplatanus* L.	Sycamore maple
1	*A. macrophyllum* Pursh	bigleaf maple
1	*A. pensylvanicum* L.	striped maple
0	*A. spicatum* Lam.	mountain maple
0	*A. barbatum* Michx.	Florida maple
0	*A. circinatum* Pursh	vine maple
0	*A. glabrum* Torr.	Rocky Mountain maple
0	*A. grandidentatum* Nutt.	bigtooth maple
0	*A. leucoderme* Small	chalk maple

Table 4 Scores assigned to host species, ranked from 1 to 10 from lowest to highest potential to spread inoculum of *Eutypella parasitica* in Europe

Host Score	Scientific name	Common name
10	*Acer pseudoplatanus* L.	Sycamore maple
8	*A. platanoides* L.	Norway maple
5	*A. campestre* L.	field maple
3	*A. monspessulanum* L.	Montpelier maple
3	*A. opalus* Mill.	Italian maple
3	*A. tataricum* L.	Tatarian maple
2	*A. cappodocicum* Gleditsch	Coliseum maple
2	*A. heldreichi* Orph. ex. Boiss.	Heldreich's maple
2	*A. hyrcanum* Fisch. & Mey.	Balkan maple
2	*A. neapolitanum* Ten.	Neapolitan maple
1	*A. lobelli* Ten.	Lobel's maple
1	*A. sempervirens* L.	Cretan maple
1	*A. velutinum* Boiss.	Velvet maple

2.2.2 Scoring temperature and moisture

Ascospore discharge is greatest at temperatures between 24 and 28 °C (Johnson & Kuntz, 1979; Lachance, 1971). Laboratory tests show no ascospore discharge and dissemination at temperatures below 4 °C and higher than 36 °C. For each month, we assigned a mean monthly temperature between 24 and 28 °C with the highest rank of 5. Temperatures outside this range were assigned progressively lower ranks (Table 5). The temperature variable was given an importance weight (W) of 2 (Table 1).

Free moisture (rainfall) must also exist on mature perithecia to induce discharge of ascospores. At least 3 mm rain has to penetrate the tree canopy to initiate discharge (Johnson & Kuntz ,1979; Lachance, 1971). Spore ejection begins about 2 hours after rain has started. For each month, we assigned monthly rainfall amounts above 100 mm the highest rank of 5, with lower ranks assigned to progressively lower rainfall amounts (Table 2; Fig. 4). High humidity alone is not sufficient to induce discharge of spores. However, high relative humidity influences the rate of drying of bark on cankers and prolongs discharge after periods of rainfall (Johnson & Kuntz, 1979). A rank of 5 was assigned to areas that experience relative humidity conditions greater than 90 %, with progressively lower ranks assigned to lower humidity levels (Table 2; Fig. 5). Rainfall and relative humidity were given importance weights (*W*) of 2 and 1, respectively (Table 1). We produced a figure for climate suitability for Eutypella canker spread which illustrates the combined effects of climate averaged over 12 months, based on the weights and ranks assigned to each climate variable (Fig. 6).

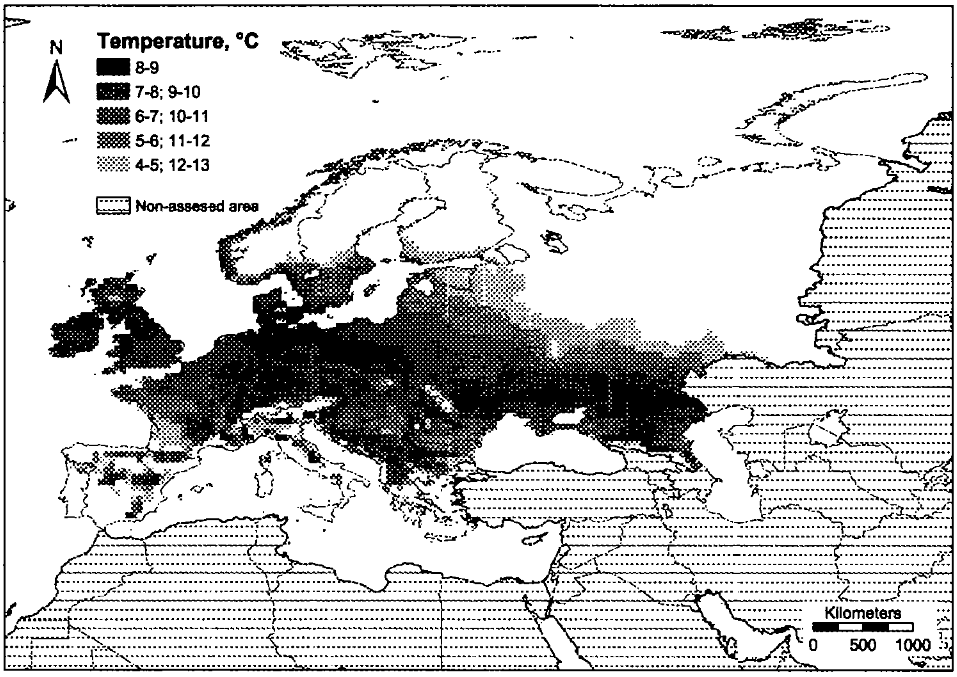

Fig. 3 Temperature suitability for *Eutypella parasitica* in Europe calibrated to temperature ranges of pathogen distribution in North America

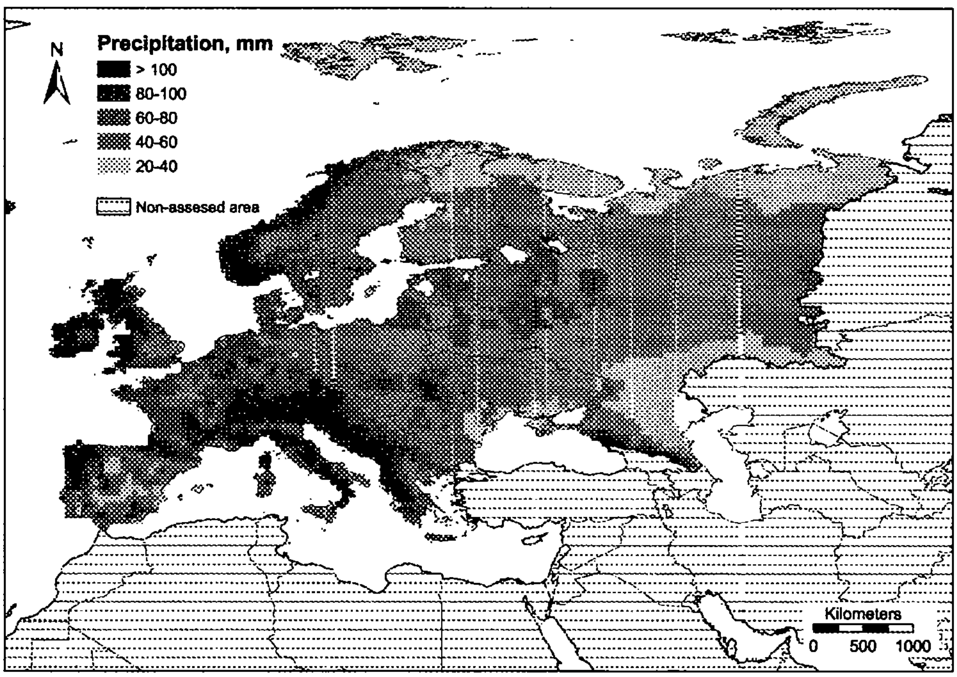

Fig. 4 Precipitation ranges in 5 ranks suited for spread of *Eutypella parasitica*

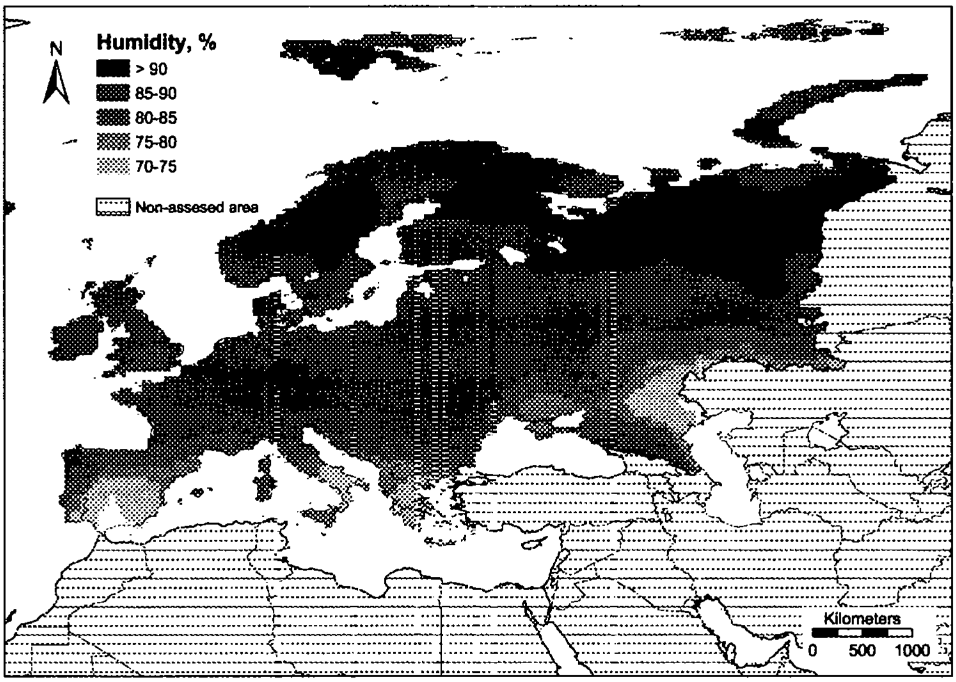

Fig. 5 Relative humidity in 5 ranks suited for spread of *Eutypella parasitica*

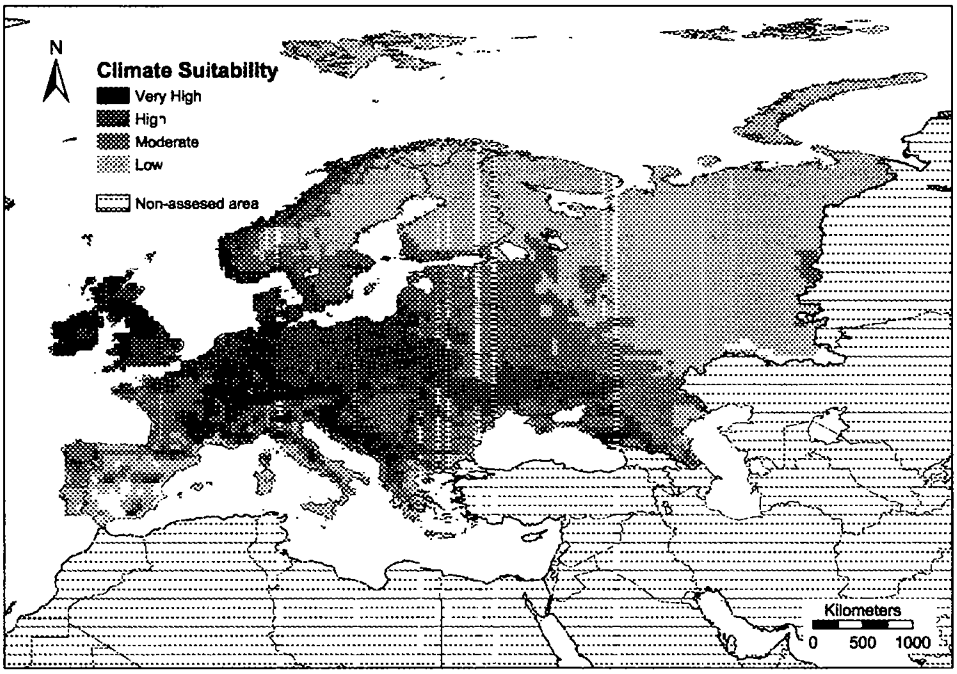

Fig. 6 Climate suitability index, based on weights and ranks assigned to each input climate variable

2.3 Calibrating the model

The model was calibrated in order to give more probable predictions of spread risk in Europe. The ranges of climate variables in Europe were calibrated to suit the Eutypella canker's natural distribution in North America. Initially, the ranges for the temperature variable used corresponded to laboratory experiments that tested pathogen temperature preference according to its growth speed, ascospore discharge and dissemination (Table 5). Those ranges of temperatures did not give a satisfactory result. Using the temperature ranges cited in Table

5, the model showed a very high spread risk in the more southern parts of North America, where no records of Eutypella canker have actually been reported. Therefore, we adjusted temperature ranges to the mean monthly temperatures around the Great Lakes where disease abundance is the greatest. The outcome of this process was the temperature ranges given in Table 2, which were later used in developing the spread risk model for Europe. The temperature range with the highest rank of 5 was radically lowered to 8-9 °C. Temperatures outside this range were assigned progressively lower ranks (Fig. 3). The low temperature range of rank 5 could show that inoculum dispersion may occur simply at temperatures higher then 4 °C and that it is not really very important how much higher. This hypothesis should be tested experimentally.

Calibration of the rainfall variable and relative humidity variable was not necessary because calibrating the temperature variable gave desired result. Figure 7 shows the spread risk map for North America, which was the result of running the model for North America. This figure shows that calibration of model was fairly successful because very high and high-risk ranks cover most of the area actually infected by *Eutypella parasitica.*

Table 5 Range of temperatures and assigned ranks from 0-5 from least to most suitable for spread of the pathogen according to laboratory experiments (Johnson & Kuntz, 1979)

Rank	Temperature (°C)
5	24-28
4	19-24; 28-30
3	14-19; 30-32
2	9-14; 32-34
1	4-9; 34-36
0	<4; >36

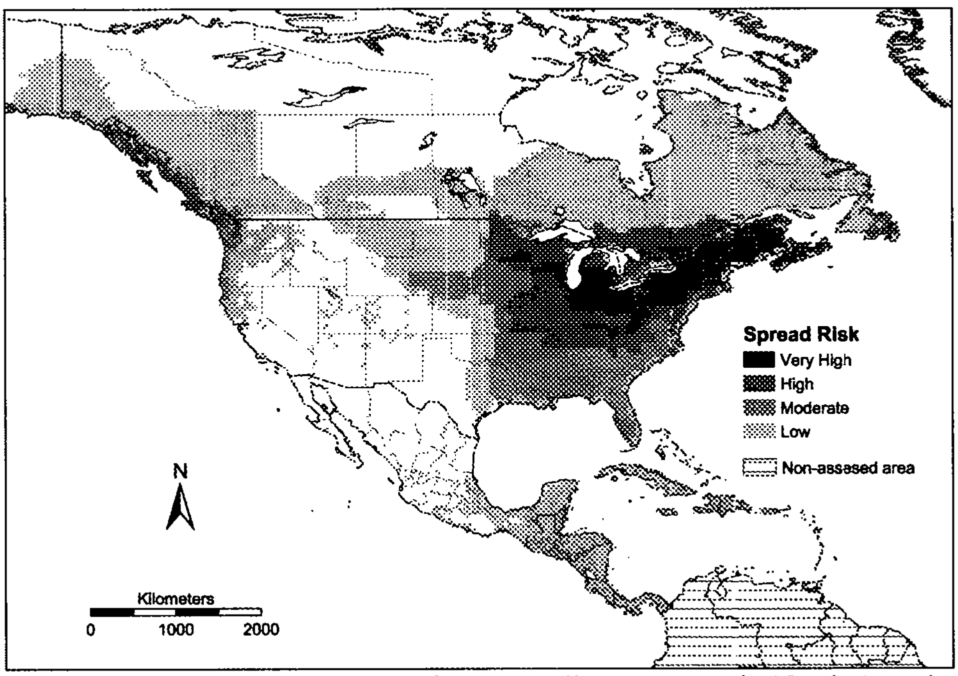

Fig. 7 Predicted spread risk map for *Eutypella parasitica* in North America

3 Results

3.1 Spread risk

The model predicts the spatial variability of *Eutypella parasitica* establishment and spread risk, based on the combined influence of the host species index and three temperature and moisture climate variables. Risk is mapped for each month and averaged to generate a cumulative spread risk map (Fig. 8). Countries are used to report the geographic range of spread risk (Table 6). The geographic range of cumulative risk of establishment and spread are summarized below for each risk level.

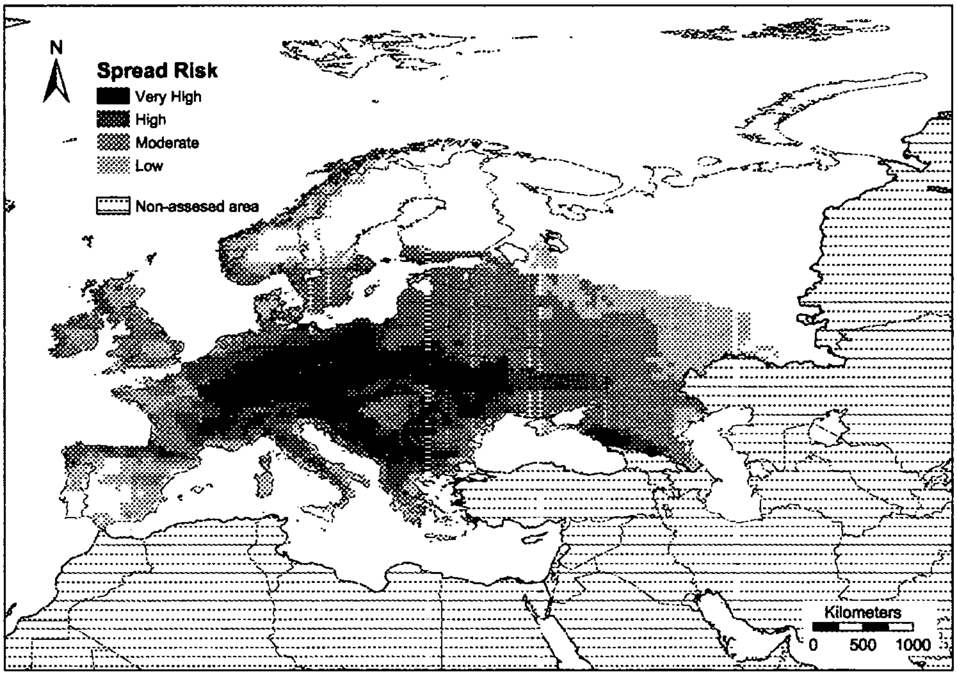

Fig. 8 Predicted spread risk map for *Eutypella parasitica* in Europe

3.1.1 Very high risk

13 % (1,404,000 km^2) of Europe's land area was mapped and found to be very high risk for *Eutypella parasitica* (Table 6; Fig. 8). The very high risk areas occur in the Balkans (Slovenia, Bosnia and Herzegovina, Serbia and Montenegro, Croatia), Southern Europe (some parts of the Apennines, the central part of the Pyrenees), Central Europe (all parts of Austria except the eastern part, the whole Czech Republic, northern and southern parts of Slovakia, central and southern part of Germany, almost all of Poland except the northeastern part), Western Europe (northern half of Switzerland, eastern part of France), and Eastern Europe (some parts of Moldova, eastern region of Ukraine, Caucasus). Very high risk regions generally cover one large contiguous area. This large contiguous area covers 1,202,000 km^2 (Table 7), while smaller areas cover only 9 % of the total very high risk area.

Sites mapped as very high risk occur where very high host index values (Fig. 2) coincide with highly suitable climate conditions (Fig. 6). Temperature and humidity are generally more suitable for the pathogen to spread in these regions, while precipitation covers all ranges, from lowest to highest. Sycamore maple, Norway maple, and field maple generally dominate very high risk forests.

3.1.2 High risk

8 % (916,000 km^2) of the European land area was mapped as a high risk area (Table 6; Fig. 8). High risk areas occur in the proximity of very high risk areas. Therefore, the high risk area is like an extension of the very high risk area. High risk areas generally occur over relatively small areas (mean = 18,785 km^2; Table 7) nestled within larger areas mapped as very high risk and its margins. The largest contiguous area measures 104,000 km^2 and crosses Bulgaria, nearly all of Macedonia, eastern Albania, and northern Greece. Another very large contiguous area of high risk encompasses 104,000 km^2 in Ukraine. The next larger contiguous area measure 93,000 km^2 and crosses the northeastern part of France, Belgium, southern Netherlands, and the northwestern part of Germany.

High risk areas occur where high and moderate host index values (Fig. 2) correspond to moderately to highly suitable climatic conditions (Fig. 6). Sycamore maple, Norway maple and field maple are generally present in high risk forests.

Table 6 Land area of each spread risk level in European countries, in square kilometres and in percent of total country area*

Country	Area	Very high risk		High risk		Moderate risk		Low risk		No risk	
	km^2	km^2	%	km^2	%	km^2	%	km^2	%	km^2	%
Albania	28,145	4,429	16	12,662	45	10,040	36	0	0	1,014	4
Austria	87,093	72,280	83	14,813	17	0	0	0	0	0	0
Belgium	32,693	1,255	4	30,777	94	1	0	0	0	660	2
Bosnia and Herzegovina	51,926	42,255	81	7,722	15	1,949	4	0	0	0	0
Bulgaria	110,443	23,355	21	43,311	39	26,453	24	13,969	13	3,361	3
Belarus	228,356	3,962	2	18,161	8	206,233	90	0	0	0	0
Croatia	56,409	32,111	57	8,427	15	11,543	20	2,031	4	2,297	4
Czech Republic	83,423	83,423	100	0	0	0	0	0	0	0	0
Denmark	48,046	0	0	0	0	3,316	7	40,234	84	4,496	9
Estonia	53,525	0	0	0	0	44,316	83	4,424	8	4,786	9
Finland	425,658	0	0	0	0	39,021	9	4,100	1	382,537	90
France	563,186	134,295	24	128,408	23	191,583	34	96,335	17	12,565	2
Germany	383,005	255,419	67	67,251	18	54,623	14	2,056	1	3,657	1
Greece	125,391	0	0	16,959	14	26,498	21	46,853	37	35,082	28
Hungary	96,064	29,774	31	10,241	11	56,050	58	0	0	0	0
Iceland	131,847	0	0	0	0	0	0	62,290	47	69,558	53
Ireland	76,229	0	0	0	0	43,574	57	28,435	37	4,221	6
Italy	298,335	39,286	13	86,801	29	49,355	17	83,810	28	39,082	13
Latvia	73,620	0	0	0	0	71,623	97	721	1	1,277	2
Lithuania	72,825	0	0	0	0	72,809	100	0	0	16	0
Macedonia	25,111	2,771	11	21,177	84	1,163	5	0	0	0	0
Moldova	34,817	18,434	53	14,122	41	2,261	6	0	0	0	0
Netherlands	38,518	0	0	8,121	21	16,016	42	11,704	30	2,677	7
Norway	525,032	0	0	602	0	36,114	7	191,641	37	296,675	57
Poland	337,614	230,775	68	51,581	15	54,208	16	0	0	1,050	0
Portugal	88,021	0	0	0	0	3,956	4	31,928	36	52,136	59
Romania	242,374	71,639	30	82,194	34	75,902	31	6,894	3	5,745	2
Russia	4,635,006	46,497	1	40,817	1	1,149,567	25	682,123	15	2,716,001	59
Serbia and Montenegro	102,340	67,642	66	15,915	16	17,846	17	0	0	938	1
Slovakia	51,336	23,010	45	26,175	51	2,150	4	0	0	0	0
Slovenia	20,880	17,136	82	2,192	10	1,552	7	0	0	0	0
Spain	486,707	2,137	0	21,787	4	91,338	19	207,022	43	164,373	34
Sweden	550,577	0	0	0	0	126,934	23	89,880	16	333,763	61
Switzerland	42,731	21,838	51	16,412	38	4,431	10	0	0	0	0
Ukraine	628,012	180,210	29	169,206	27	241,537	38	19,443	3	17,615	3
United Kingdom	270,101	0	0	0	0	141,648	52	107,532	40	20,922	8
Totals	11,105,405	1,404,033	13	915,835	8	2,875,609	26	1,733,424	16	4,176,503	38

*Note: Total country area can differ considerably from actual country area (e.g., for very large countries the error can be as much as 10,000 km^2 high or higher with wider countries). One reason for this is coarseness of the country boundaries used in the model. Therefore, countries smaller than 10,000 km^2 were left out. Proportions and percentages are more important in those cases.

3.1.3 Moderate risk

26 % (2,876,000 km^2) of Europe's land area was mapped as moderate risk (Table 6; Fig. 8). Moderate risk areas are generally higher in area (mean = 37,327 km^2) than high risk areas (Table 7). The largest patch (1,667,000 km^2) of moderate risk forest lies across a wide area of Eastern Europe (northeastern Poland, Lithuania, Latvia, Estonia, Belarus, northern and southern Ukraine, and eastern Russia). The second largest contiguous area (128,000 km^2) of moderate risk encompasses the central and southwestern part of France. Third largest moderate risk area (119,000 km^2) lies in southern Sweden.

Moderate risk areas occur over moderate and low host index values (Fig. 2). Climate suitability in these regions is moderate and low rank. Moderate risk areas are scattered where precipitation is moderate or of lower rank. temperatures are less suitable for pathogen spread, and across all humidity levels. Areas of moderate risk are generally near coastlines or deep within the continent.

Table 7 Europe-wide statistics for areas mapped at the four predicted spread risk levels

Risk	Area (km^2)			
	Maximum	Minimum	Mean	S.D.
Very High	1,201,982	2,149	89,587	307,924
High	103,885	1,577	18,785	25,898
Moderate	1,667,102	1,577	37,327	194,048
Low	600,046	1,364	17,688	63,387

3.1.4 Low risk

16 % (1,733,000 km^2) of Europe was mapped as low risk (Table 6; Fig. 8). Low risk areas generally cover relatively small areas (mean = 17,688 km^2; Table 7) at the margins of larger areas mapped as higher risk. The regions are usually along coastlines and even deeper inside the continent than regions ranked moderate risk. Low risk regions have low and very low suitable climate rankings and low temperature ranks, while precipitation and humidity may encompass all ranges. Host index values in these regions are low and very low. Low risk regions are characterized by species that have not yet been identified as hosts, but rather as potential hosts. A very large part of low risk regions do not have host species at all. The largest contiguous area occurs in Russia. Denmark, large areas of Norway, Spain, and the United Kingdom are mapped as low risk.

4 Discussion

Eutypella parasitica is currently established in Slovenia in the surroundings of Ljubljana and in the eastern part of Slovenia (Fig. 1). The risk of continued spread and establishment of *Eutypella parsitica* in Slovenia and Europe reflects spatial variability in host vegetation and climate. The model described here matches the distribution of the disease in North America. However, the model predicts disease spread further south of the established area in North America. This result suggests either that there is a large amount of currently uninfected area in North America or that the model does not take into account some other important variable or variable range.

The data show that 41 % of the very high risk area in North America is mapped outside where *Eutypella parasitica* is currently present. There are several possible reasons for this. First, the host species index was built upon the possible natural distribution of the host species (*Acer* spp.), which do not show actual state of host species present at a specific location. We are aware that there is a lack of data on the actual abundance of maples, which could change the host species index substantially and consequently the spread risk map. The model's input variables are mapped at coarse scale, although the disease can occur at a finer scale.

Not everything about Eutypella canker is known and this leaves us with only a limited understanding of the processes that may contribute to disease establishment and spread. The model presented here examines the likelihood that a site is invaded, that *Eutypella parasitica* is established, and that subsequently the site serves as a source of inoculum for further spread in the local area. A site with few, or no, hosts would have low spread risk because it is less likely to serve as a source of inoculum for further spread. However, such sites (e.g. containing a maple species that has not yet been reported as a susceptible species) may still be invaded and the pathogen established within a tree's lifetime. Long-term establishment of a *Eutypella parasitica* population requires the disease to be transmitted to at least one other susceptible individual.

There are multiple spread pathways for *Eutypella parasitica*. Natural spread is most likely over relatively short distances, about 25 m downwind from the canker (Johnson & Kuntz, 1979). It is possible that longer dispersal distances may also be achieved during rare storm events.

Humans probably have a considerable influence on the long-distance spread of *Eutypella parasitica*. Movement of ornamental trees such as red maple (*Acer rubrum*), boxelder (*Acer negundo*), and silver maple (*Acer saccharinum*) is the most likely source of long distance spread. Spread of *Eutypella parasitica* via ornamentals has most likely already occurred in Europe. Although the evidence is anecdotal, initial outbreaks of Eutypella canker have been associated with plantings of ornamental red maple in Tivoli Park, Ljubljana, Slovenia. Infected saplings of susceptible maples are one possible pathway of disease spread. Infected logs from susceptible maples are the second most probable pathway. The fungus survives in transit as ascospores in perithecia or as mycelium in wood and bark. It can survive existing cultivation or commercial practices, because it can survive in infected wood without bark and can produce ascomata in or on wood. Fallen off infected bark and infected wood residues from manufacturing process are other possible sources of infection.

Differences in susceptibility to *Eutypella parasitica* among host populations may influence establishment and spread of the pathogen across a given landscape. If significant, population susceptibility could be mapped as a variable and used to improve model performance.

Research is also needed to determine the degree to which the spatial arrangement of host vegetation across a landscape influences disease establishment and spread. As with other dispersing organisms, small stands and isolated stands of host vegetation are less likely to be colonized successfully by *Eutypella parasitica* than larger stands or those close to other stands of host vegetation.

The climate data used in the model effectively characterizes the general moisture and temperature regimes suitable for *Eutypella parasitica*. However, the pathogen does not sporulate and spread in response to the average climate. We hypothesize that *Eutypella* *parasitica* likely spreads in response to specific weather events, such heavy rain during spring or autumn. Experiments are needed to better understand infection rates in various hosts as a function of moisture and temperature. This information could be valuable for refining the scores and weights assigned to each variable in the development of the model. This information may also be used along with spatial modelling techniques to develop a cellular automata model of disease spread through time based on statistical probabilities of dispersal and infection processes.

When new threats to plants are found or predicted a Pest Risk Analysis is usually carried out which evaluates biological or other scientific and economic evidence to determine whether a pest should be regulated. The model described here can significantly lower the degree of uncertainty of Pest Risk Analysis.

In conclusion, the model's predictions of spread risk are generally consistent with established disease areas in North America. The model identifies an alarming area of uninfected forests in Europe at considerable risk of infection by *Eutypella parasitica*. It is essential that we prevent long distance spread of the pathogen, a threat that could very much alter the forests of Europe. Although much remains to be learned about the ecology and epidemiology of the Eutypella canker, the model presented here provides a simple, yet informative tool enabling us to target threatened forests for monitoring and protection.

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PEST: *Eutypella parasitica* R.W. Davidson & R.C. Lorenz..

ASSESSOR *doc. dr. Dušan Jurc and Nikica Ogris*...**DATE**...15. 9. 2005......   **TIME NEEDED**...3 DAYS..........

DATA AVAILABLE ....

DECISION-MAKING SCHEME
Stage 1: Initiation

Identify pest

PRA Procedure - Questions	Answer	Comments / Supporting evidence
1. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank? **if yes Go to 3** **if no Go to 2**	**YES**	The fungus was described in 1938 and since then its nomenclature has not changed; it has no synonyms or invalid names.
2. Attempt to redefine the taxonomic entity so that the criteria under 1 are satisfied. Is this possible? **if yes Go to 3** **if no Go to 22**		

The PRA area

3. Clearly define the PRA area. **Go to 4**	**Slovenia and Europe**	

Earlier analysis

4. Does a relevant earlier PRA exist? **if yes Go to 5** **if no Go to 7**	**NO**	
5. Is the earlier PRA still entirely valid, or only partly valid (out of date, applied in different circumstances, for a similar but distinct pest)? **if entirely valid End** **if partly valid Go to 6** **if not valid Go to 7**		
6. Proceed with the assessment, but compare as much as possible with the earlier assessment. **Go to 7**		

STAGE 2: PEST RISK ASSESSMENT
Section A: Pest categorization (qualitative criteria of a quarantine pest)

Geographical criteria

PRA Procedure - Questions	Answer	Comments / Supporting evidence
7. Does the pest occur in the PRA area? **if yes Go to 8** **if no Go to 9**	**YES**	Europe: Slovenia, surroundings of Ljubljana
8. Is the pest of limited distribution in the PRA area? **if yes Go to 18** **if no Go to 22**	**YES**	Air distance between the two most distant infections is 10.6 km

Potential for establishment

9. Does at least one host plant grow to a substantial extent in the PRA area, in the open, in protected conditions or both? **if yes Go to 10** **if no Go to 22**		
10. Does the pest have to pass part of its life cycle on a host plant other than its major host (i.e. obligate alternate host plant)? **if yes Go to 11** **if no Go to 12**		
11. Does the alternate host plant also occur in the same part of the PRA area as the major host plant ? **if yes Go to 12** **if no Go to 22**		
12. Does the pest require a vector (i.e. is vector transmission the only means of dispersal)? **if yes Go to 13** **if no Go to 14**		
13. Is the vector (or a similar species which is known or suspected to be a vector) present in the PRA area or likely to be introduced. If in doubt, a separate assessment of the probability of introduction of the vector (in section B1) may be needed. **if yes Go to 14** **if no Go to 22**		
14. Does the known geographical distribution of the pest include ecoclimatic zones comparable with those of the PRA area? **if yes Go to 18** **if no Go to 15**		

PRA Procedure - Questions	Answer	Comments / Supporting evidence

15. Is it probable, nevertheless, that the pest could survive and thrive in a wider ecoclimatic zone that could include the PRA area? **if yes Go to 18** **if no Go to 16**		
16. Could the ecoclimatic requirements of the pest be found in protected conditions in the PRA area? **if yes Go to 17** **if no Go to 22**		
17. Is a host plant grown in protected conditions in the PRA area? **if yes Go to 18** **if no Go to 22**		

Potential economic importance

18. With specific reference to the host plant(s) which occur(s) in the PRA area, and the parts of those plants which are damaged, does the pest in its present range cause significant damage or loss? **if yes Go to 21** **if no Go to 19**	**NO**	Up to the date of completion of this PRA (15. 9. 2005) the disease was found in 47 sycamore maples (*Acer pseudoplatanus* L.) and 5 field maples (*Acer campestre* L.). Thorough monitoring of the area at risk has not yet been performed fully.
19. Could the pest, nevertheless, cause significant damage or loss in the PRA area, considering ecoclimatic and other factors for damage expression? **if yes Go to 21** **if no Go to 20**	**YES**	Disease development is extremely slow, many infections are probably overlooked, and the range of the disease is probably larger than originally thought.
20. Would the presence of the pest cause other negative economic impacts (social, environmental, loss of export markets)? **if yes Go to 21** **if no Go to 22**		

21. This pest could present a risk to the PRA area

22. This pest does not qualify as a quarantine pest for the PRA area and the assessment can stop. However, if this is the first time that the decision-making scheme has directed you to this point, it may be worth returning to the question that led you here and continuing through the scheme in case the remaining questions strongly indicate categorization as a possible quarantine pest. In this latter case, seek a second opinion to decide whether the answers which led you to this point could be given a different reply.

Section B: Quantitative evaluation

1 Probability of introduction

PRA Procedure - Questions	Answer	Comments / Supporting evidence

Entry

List the pathways that the pest could be carried on.		
1.1 How many pathways could the pest be carried on? **(few = 1; many =9)**	**2**	Infected plants (saplings of susceptible maples) and infected logs of susceptible maples.
1.2 **For each pathway, starting with the most important pathway identified above (i.e. that which carries the greatest trade or which is most likely to act as a means of introduction) and then in descending order of importance, answer questions 1.3 – 1.13. If one of the questions 1.3a, 1.5a, 1.7a or 1.12a is answered by 'no', the pathway could not act as a means of entry for the pest, and the scheme will return directly to this point, omitting later questions. Use expert judgement to decide how many pathways to consider.** **Infected logs of susceptible maples** **Go to 1.3**		
1.3a Could the pest be associated with the pathway at origin? **if yes Go to 1.3b** **if no Go to 1.2**	**YES**	The natural range of the fungus is found in the USA (Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York State, Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont) and in Canada (Ontario, Quebec).
1.3b How likely is the pest to be associated with the pathway at origin? **(not likely = 1; very likely = 9)**	**2**	
1.4 Is the concentration of the pest on the pathway at origin likely to be high? **(not likely = 1; very likely = 9)**	**2**	In the area of natural occurrence of the disease in North America an average of 5% of maples are diseased, however there are sites with up to 40% infected maples in a stand.
1.5a Could the pest survive existing cultivation or commercial practices? **if yes Go to 1.5b** **if no Go to 1.2**	**YES**	The fungus usually produces ascomata in bark, but can survive in infected wood without bark and produces ascomata in wood.
1.5b How likely is the pest to survive existing cultivation or commercial practices? **(not likely = 1; very likely = 9)**	**9**	
1.6 How likely is the pest to survive or remain undetected during existing phytosanitary procedures? **(not likely = 1; very likely = 9)**	**7**	
1.7a Could the pest survive in transit? **if yes Go to 1.7b** **if no Go to 1.2**	**YES**	The fungus survives as ascospores in perithecia or as mycelium in wood and bark.

PRA Procedure - Questions		Answer	Comments / Supporting evidence
1.7b	How likely is the pest to survive in transit? **(not likely = 1; very likely = 9)**	**9**	
1.8	Is the pest likely to multiply during transit? **(not likely = 1; very likely = 9)**	**1**	The fungus can release ascospores but it cannot carry out its whole life cycle.
1.9	How large is movement along the pathway? **(not large = 1; very large = 9)**	**2**	North America – ship – harbour in Europe (Slovenia: Port of Koper) – customs – recipient (wood processing enterprise).
1.10	How widely is the commodity to be distributed throughout the PRA area? **(not widely = 1; very widely = 9)**	**2**	Logs are delivered to one or only a few enterprises.
1.11	How widely spread in time is the arrival of different consignments? **(not widely = 1; very widely = 9)**	**9**	We have no data on this issue.
1.12a	Could the pest transfer from the pathway to a suitable host? **if yes Go to 1.12b** **if no Go to 1.2**	**YES**	
1.12b	How likely is the pest to be able to transfer from the pathway to a suitable host? **(not likely = 1; very likely = 9)**	**2**	
1.13	Is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste) likely to aid introduction? **(not likely = 1; very likely = 9)**	**2**	Fallen off infected bark and infected wood residue from manufacturing process are possible sources of infection.

1.2 **For each pathway, starting with the most important pathway identified above (i.e. that which carries the greatest trade or which is most likely to act as a means of introduction) and then in descending order of importance, answer questions 1.3 – 1.13. If one of the questions 1.3a, 1.5a, 1.7a or 1.12a is answered by 'no', the pathway could not act as a means of entry for the pest, and the scheme will return directly to this point, omitting later questions. Use expert judgement to decide how many pathways to consider.**

Infected plants (saplings of susceptible maples)

Go to 1.3

1.3a	Could the pest be associated with the pathway at origin? **if yes Go to 1.3b** **if no Go to 1.2**	**YES**	The natural range of the fungus is found in the USA (Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York State, Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont) and Canada (Ontario, Quebec).
1.3b	How likely is the pest to be associated with the pathway at origin? **(not likely = 1; very likely = 9)**	**2**	

PRA Procedure - Questions	Answer	Comments / Supporting evidence
1.4 Is the concentration of the pest on the pathway at origin likely to be high? **(not likely = 1; very likely = 9)**	**2**	
1.5a Could the pest survive existing cultivation or commercial practices? **if yes Go to 1.5b** **if no Go to 1.2**	**YES**	
1.5b How likely is the pest to survive existing cultivation or commercial practices? **(not likely = 1; very likely = 9)**	**9**	
1.6 How likely is the pest to survive or remain undetected during existing phytosanitary procedures? **(not likely = 1; very likely = 9)**	**7**	
1.7a Could the pest survive in transit? **if yes Go to 1.7b** **if no Go to 1.2**	**YES**	
1.7b How likely is the pest to survive in transit? **(not likely = 1; very likely = 9)**	**9**	
1.8 Is the pest likely to multiply during transit? **(not likely = 1; very likely = 9)**	**1**	The saplings in trade are less than 5 years old. The fungus produce spores on the infected host 5-7 years after infection, thus the spores cannot be produced in saplings.
1.9 How large is movement along the pathway? **(not large = 1; very large = 9)**	**5**	North America – ship – harbour in Europe (Slovenia: Port of Koper) – customs – recipient (importer) – small firm (nursery, gardening centre) – customer.
1.10 How widely is the commodity to be distributed throughout the PRA area? **(not widely = 1; very widely = 9)**	**5**	Nurseries sell saplings to customers in Slovenia and neighboring countries.
1.11 How widely spread in time is the arrival of different consignments? **(not widely = 1; very widely = 9)**	**2**	We have no data on this issue
1.12a Could the pest transfer from the pathway to a suitable host? **if yes Go to 1.12b** **if no Go to 1.2**	**YES**	A perennial canker will be produced on infected saplings, spores will then be produced and dispersed.
1.12b How likely is the pest to be able to transfer from the pathway to a suitable host? **(not likely = 1; very likely = 9)**	**5**	

PRA Procedure - Questions	Answer	Comments / Supporting evidence
1.13 Is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste) likely to aid introduction? **(not likely = 1; very likely = 9)**	**7**	

Establishment

1.14 How many host-plant species are present in the PRA area? **(one or very few = 1; many = 9)**	**3**	*Acer pseudoplatanus*, *A. platanoides*, *A. campestre*; the susceptibility of other autochtonous species of maples (*Acer* spp.) in Europe is not known. Other susceptible species of maples from North America (*A. saccharum* Marsh., *A. rubrum* L., *A. negundo* L., *A. saccharinum* L., *A. nigrum* Mich., *A. pennsylvanicum* L.) are planted in the PRA area as ornamental tree species.
1.15 How extensive are the host plants in the PRA area? **(rare = 1; widespread = 9)**	**8**	Natural areal of maples in Europe comprises the majority of the continent, *Acer pseudoplatanus* is the seventh most frequent tree species in Slovenia, its wood stock is 7,492,000 000 m^3, *A. campestre* wood stock is 146,000 m^3, *A. platanoides* wood stock is 121,000 m^3.
1.16 If an alternate host is needed to complete the life cycle, how extensive are such host plants in the PRA area? **(rare = 1; widespread = 9)**		The fungus has no alternate host.
1.17 *[1]If a vector is needed for dispersal, how likely is the pest to become associated with a suitable vector? **(not likely – 1; very likely – 9)**		The fungus has no vector.
1.18 (Answer this question only if protected cultivation is important in the PRA area.) Has the pest been recorded on crops in protected conditions elsewhere? **(no = 1; often = 9)**		We have no data on this issue.
1.19 How likely are wild plants (i.e. plants not under cultivation, including weeds, volunteer plants, feral plants) to be significant in dispersal or maintenance of populations? **(not likely = 1; very likely = 9)**	**9**	The majority of maples are wild, relatively small numbers are planted as ornamentals.

[1] Questions marked with an asterisk are to be considered as more important than the others in the same section.

PRA Procedure - Questions	Answer	Comments / Supporting evidence
1.20 *How similar are the climatic conditions that would affect pest establishment in the PRA area and in the area of origin? **(not similar = 1; very similar = 9)**	**9**	The temperature and moisture conditions over most of the European range of maples are suitable for growth and reproduction of the fungus.
1.21 How similar are other abiotic factors in the PRA area and in the area of origin? **(not similar = 1; very similar = 9)**	**9**	
1.22 How likely is the pest to have competition from existing species in the PRA area for its ecological niche? **(very likely = 1; not likely = 9)**	**9**	After infection of the host the fungus is the sole inhabitant of the wound, in later phases of the disease, when an open wound is produced, other fungi can also inhabit the wound but these do not have a negative influence on the pathogen.
1.23 How likely is establishment to be prevented by natural enemies already present in the PRA area? **(very likely = 1; not likely = 9)**	**9**	The fungus has no natural enemies in the PRA area.
1.24 *If there are differences in the crop environment in the PRA area to that in the area of origin, are they likely to aid establishment? **(not likely = 1; very likely = 9)**		None that are known to us.
1.25 Are the control measures which are already used against other pests during the growing of the crop likely to prevent establishment of the pest? **(very likely = 1; not likely = 9)**	**7**	Thinnings and sanitary fellings of diseased trees are performed during regular silviculture and tending procedures in forests. The intensity of these measures is in our opinion too low to control the disease.
1.26 *Is the reproductive strategy of the pest and duration of life cycle likely to aid establishment? **(not likely = 1; very likely = 9)**	**2**	The reproductive cycle of the fungus is relatively lengthy and prevents its rapid establishment over an extensive area.
1.27 How likely are relatively low populations of the pest to become established? **(not likely = 1; very likely = 9)**	**9**	The fungus produce spores in great numbers in a single infected host throughout the entire vegetative period and for up to decades.
1.28 How probable is it that the pest could be eradicated from the PRA area ? **(very likely = 1; not likely = 9)**	**6**	We estimate the probability of eradication at more than 50% if the right measures are implemented in a comprehensive, accurate, and competent manner.
1.29 How genetically adaptable is the pest? **(not adaptable = 1; very adaptable = 9)**	**3**	Adaptability and specialization of the fungus to particular hosts was not investigated, but inoculations of red maple (*Acer rubrum*) have shown that some specialization of the fungus exists. Isolates of the fungus from sugar maple (*A. saccharum*) have only rarely been capable of producing infection in wounds on red maple (Lachance and Kuntz 1966)
1.30 *How often has the pest been introduced into new areas outside its original range? **(never = 1; often = 9)**	**1**	Introduction has probably occurred only once.

2 Economic Impact Assessment

2.1	*How important is economic loss caused by the pest within its existing geographic range? **(little importance = 1; very important = 9)**	**6**	In the area of natural occurrence of the disease in North America an average of 5% of maples are diseased, however there are sites with up to 40% infected maples in a stand. Infected maples have 50% less marketable wood than healthy maples.
2.2	How important is environmental damage caused by the pest within its existing geographic range? (little importance = 1; very important = 9)	**4**	Maples with advanced cankers are prone to windbreak.
2.3	How important is social damage caused by the pest within its existing geographic range? **(little importance = 1; very important = 9)**	**3**	Infected trees have reduced aesthetic value in urban environments and in forests.
2.4	*How extensive is the part of the PRA area likely to suffer damage from the pest? **(very limited – 1; whole PRA area = 9)**	**6**	Probably all areas containing maples in Europe. 18% of the PRA area has a high probability, 57% of the PRA area has a lower probability.
2.5	*How rapidly is the pest liable to spread in the PRA area by natural means? **(very slowly = 1; very rapidly = 9)**	**1**	The actual diseased area is small in spite of long establishment of the disease.
2.6	How rapidly is the pest liable to spread in the PRA area by human assistance? **(very slowly = 1; very rapidly = 9)**	**3**	The spread of infected saplings and infected maple logs with bark from a diseased area is likely.
2.7	How likely is it that the spread of the pest could be contained within the PRA area? **(very likely = 1; not likely = 9)**	**7**	Characteristics of fungal biology (slow development, slow spread, special requirements for infection of the host) are in favour of its slow spread and our ability to eradicate it.
2.8	*Considering the ecological conditions in the PRA area, how serious is the direct effect of the pest on crop yield and/or quality likely to be? **(not serious = 1; very serious = 9)**	**5**	Eutypella canker of maple destroys 50% of the marketable wood volume of diseased trees.
2.9	How likely is the pest to have a significant effect on producer profits due to changes in production costs, yields, etc., in the PRA area? **(not likely = 1; very likely = 9)**	**2**	If we assume that the average disease incidence for the PRA area is 5% (the same as it is in Eutypella canker's natural range in North America) and if we take into account that the loss of marketable wood from diseased maples is 50%, then the predicted loss in the PRA area is 2.5% less maple wood. There will be minimal higher production costs.
2.10	How likely is the pest to have a significant effect on consumer demand in the PRA area? **(not likely = 1; very likely = 9)**	**1**	

PRA Procedure - Questions		Answer	Comments / Supporting evidence
2.11	How likely is the presence of the pest in the PRA area to affect export markets? **(not likely = 1; very likely = 9)**	**3**	
2.12	How important would other costs resulting from introduction be? **(little importance = 1; very important = 9)**	**3**	
2.13	How important is the environmental damage likely to be in the PRA area? **(little importance = 1; very important = 9)**	**4**	
2.14	How important is the social damage likely to be in the PRA area? **(little importance = 1; very important = 9)**	**2**	
2.15	How probable is it that natural enemies, already present in the PRA area, will affect populations of the pest if introduced? **(very likely = 1; not likely = 9)**	**8**	Snails (Gastropoda) have been found on Eutypella canker wounds and were consuming fungal fruit bodies. Groups of Diplopoda (Myriapoda) have also been observed. Both groups of animals probably influence the production of spores.
2.16	How easily can the pest be controlled? **(easily = 1; with difficulty = 9)**	**5**	Many infections will be overlooked because of the slow development of the disease.
2.17	How likely are control measures to disrupt existing biological or integrated systems for control of other pests? **(not likely = 1; very likely = 9)**	**1**	
2.18	How likely are control measures to have other undesirable side-effects (for example on human health or the environment)? **(not likely = 1; very likely = 9)**	**2**	Burning of the diseased parts of the tree can cause forest fires.
2.19	Is the pest likely to develop resistance to plant protection products? **(not likely = 1; very likely = 9)**		Not important.

3 Final Evaluation

Comments:
Eradication of Eutypella canker of maple in Slovenia is proposed.

In favor of this proposal are the following biological properties of the pathogen:

- The development and life cycle of the disease are substantially slower than in comparable canker diseases
- The fungus can infect the host only through special entry points (branches, deep wounds in sapwood)
- Ascospores are distributed only over short distances from the source (i.e. old infection)

Against the attempt for the eradication are the following facts:

- The age of infections found in Slovenia is very high (more than 20-30 years). The exact age will be determined by dissection of older canker wounds in the future. Thus, it is very likely that the actual spread is larger than previously established.
- Detection of the disease in the early phases of development is impossible in the field (the symptoms are not visible to the naked eye for as long as 5 years after the initial infection)

If the disease is not eradicated in Slovenia then it will without a doubt eventually spread into areas with sensitive maples within Europe. Spread will be relatively slow, but certain and continuous. It could be accelerated by trade with diseased plants (saplings) or infected wood and transported to new locations within the PRA area. In this case the disease could spread through any entry point.

Taking into consideration all arguments for and against the eradication of Eutypella canker in Slovenia we conclude that the expected ecological and economic damages due to this disease are such that suitable efforts and funds should be invested in its total eradication from Slovenia and Europe.

Priloga 9:

Ogris. N., Jurc D., 2005: Ugotavljanje razširjenosti javorovega raka v Sloveniji – nadaljevanje. Metode dela. Predstavljeno na seminarju za popis razširjenosti javorovega raka v Sloveniji, Ljubljana – Tivoli, 27. 9. 2005, 15 str.

Nikica Ogris,Dušan Jurc

Ugotavljanje razširjenosti javorovega raka v Sloveniji - nadaljevanje

Metode dela

Predstavljeno na Seminarju za popis razširjenosti javorovega raka v Sloveniji, Ljubljana - Tivoli, 27.9.2005

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Namen dela

- Brez podatka o razširjenosti bolezni se ne moremo odločiti, kako bomo ukrepali
- Če bo razširjenost majhna in omejena na posamezna žarišča, bomo morda bolezen lahko izkoreninili oz. močno omejili
- Če bo razširjenost velika, morda po celi Sloveniji, bolezni ne bomo mogli izkoreniniti, ampak bomo le zmanjševali njeno škodljivost s smiselnimi ukrepi

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Delo revirnega gozdarja

- **Vsebina pregleda:**
  - pregled vseh vrst javorov: **gorski javor**, **maklen**, **ostrolistni javor**, trokrpi javor, topokrpi, tatarski, okrasni (**rdeči**, **ameriški**, srebrni, japonski, pahljačasti)
  - najprej območja, kjer je javorja največ (po LZ ali številu osebkov)
  - Na kartah Prioritetna območja I in Prioritetna območja II je nakazano, kje je največja verjetnost novih nahajališč javorovega raka

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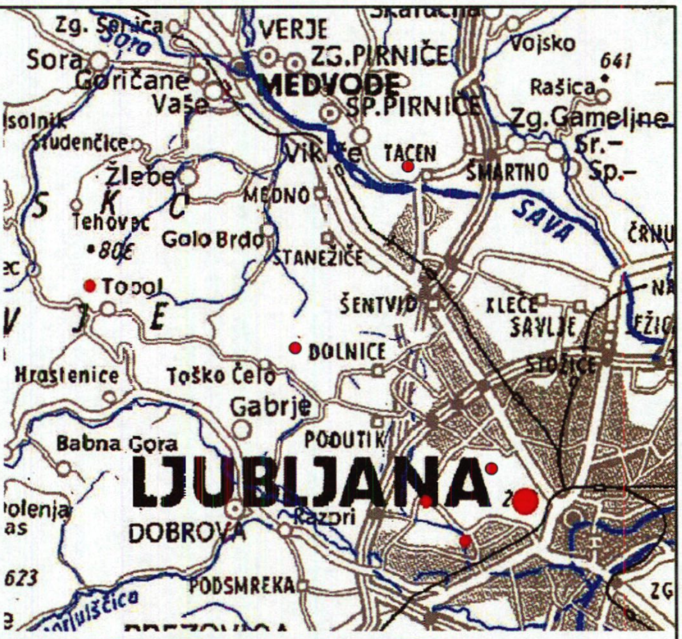
Razširjenost

- Slovenija (stanje na 15.9.2005)



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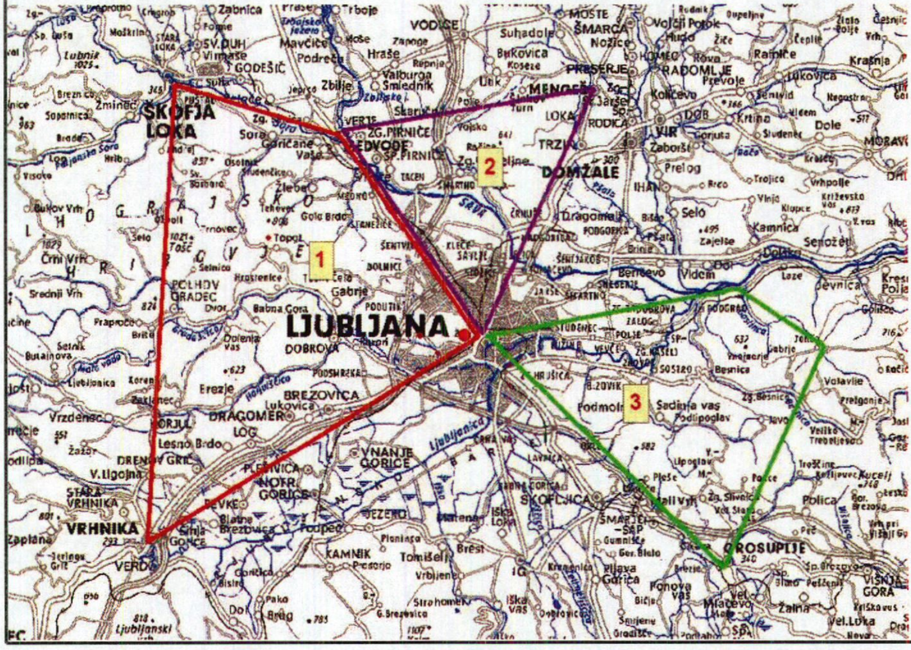
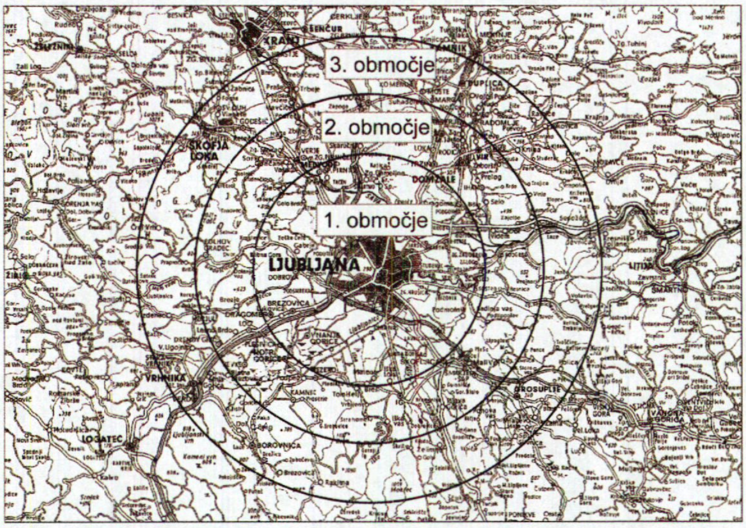
Prioritetna območja I – v območju 1 in 2 je javorov rak že najden, v 3 še ne



Prioritetna območja II – v 1. območju je javorov rak že najden, v 2. in 3. še ne, zato mora biti intenzivnost pregledov v območjih 2 in 3 največja!



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Način poročanja

- Vsaka sumljiva okužba javorja se **označi s trakom ali barvo**, tako, da je drevo mogoče ponovno najti
- Kraj sumljive okužbe se **vriše v karto**
- Podatek se **vpiše v XLS** preglednico
- Naslov:
  \\Zgs1\ftp\OE00ZGS\Oddelek III\PDP\javorov_rak

GGO	ODSEK	GE	REVIR	DATUM	DV	ŠT. PREGLEDANIH	ŠT. OKUŽENIH starost 1	ŠT. OKUŽENIH starost 2	ŠT. OKUŽENIH starost 3

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Način poročanja

- Starost okužbe
  - 1. mlada okužba

trosišča prisotna,
skorja ne odpada

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Način poročanja

- Starost okužbe
  - 2. razvita okužba

skorja v sredini raka odpada, na robovih so trosišča, deformacija debla

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Način poročanja

- Starost okužbe
  - 3. stara okužba

skorja je že odpadla na večjem delu raka, rak je objel že skoraj cel obod

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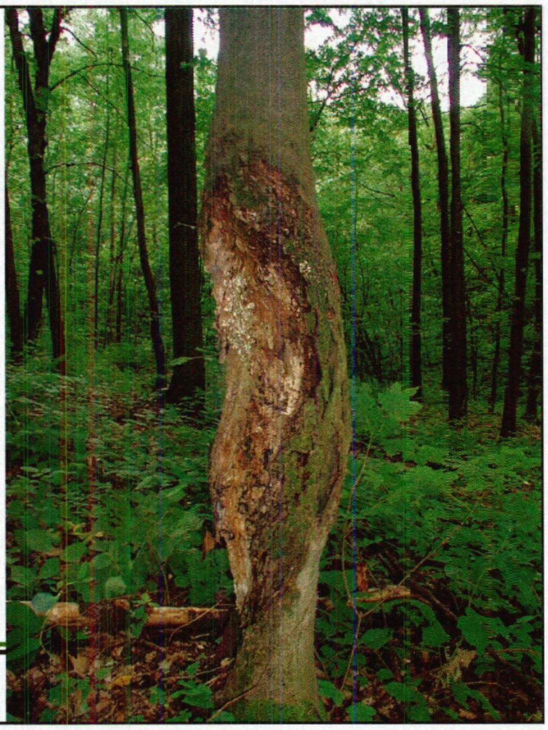

Simptomi

- Večina okužb je na deblu do višine 3,7 m

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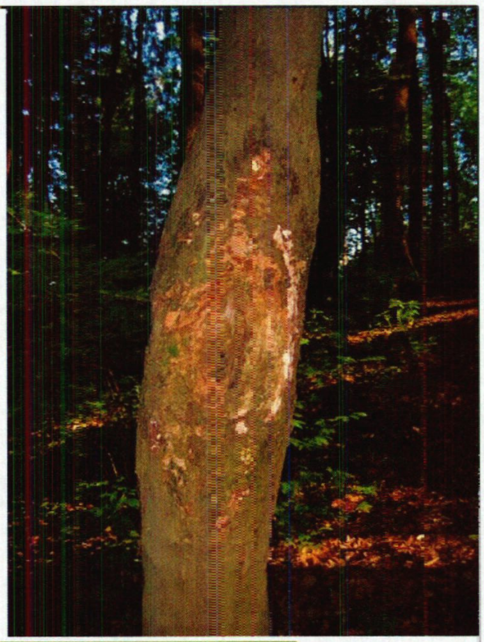
Simptomi

- Gliva na leto prirašča le en ali dva centimetra po višini raka, po širini še manj



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Simptomi

- Zaradi dolgotrajne okuženosti in skupne rasti glive in drevesa je deblo običajno zakrivljeno, deformirano

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Simptomi

- Raki so zelo pravilne, ovalne oblike

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Simptomi

- Črna trosišča, deformacija debla, rahlo odebeljen rob rakave rane

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Simptomi

- Zelo neopazne so mlade okužbe.
- Na sredini okužbe je običajno odmrla veja.
- Če je rak star več kot 5 let so na odmrli skorji črna trosišča glive
- Skorja je rahlo ugreznjena

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Simptomi

- Stari raki lahko obsegajo večino oboda debla

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Simptomi

- Mlada, težko opazna okužba – na robu rakave rane so temnejši predeli, kjer se po dežju izceja črna tekočina
- Na najstarejšem delu rane se oblikujejo črna trosišča

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Simptomi

- Stare rakave rane so opazne že od daleč
- V les so se naselile glive, ki razgrajajo les in lahko oblikujejo na njem trosnjake – kožaste, luknjičaste, rjave, bele itd.

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Simptomi

- Javorov rak v Ameriki na sladkornem javoru
- Za razliko od okužb na gorskem javoru so ti raki zveriženi in rob deformiran, ker je gliva na zunanjih delih raka odmrla in drevo nepravilno zarašča rano

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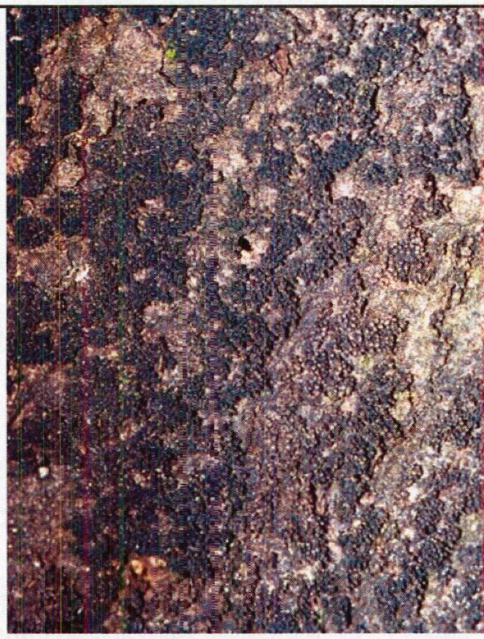
Simptomi

- Trosišča na skorji



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Simptomi

- Trosišča na lesu

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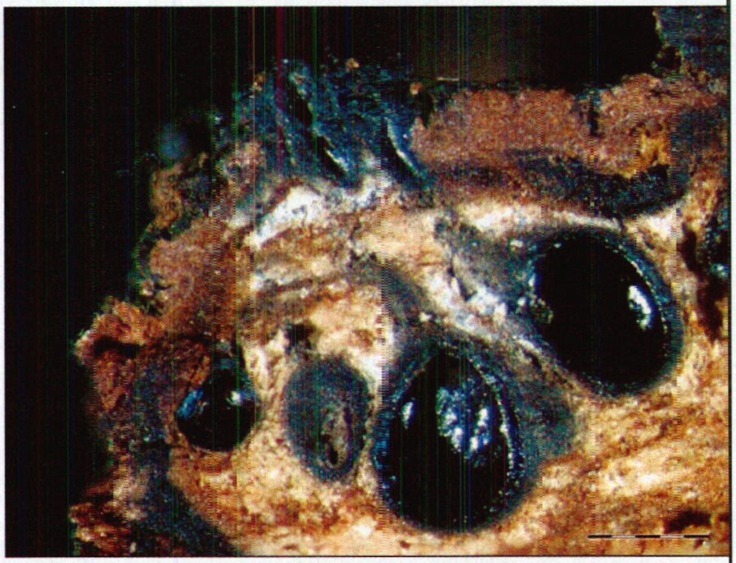
Simptomi

- periteciji



Simptomi

- Ležeče, odlomljeno deblo, na njem številna črna trosišča glive
- Deblo se je prelomilo na rakavem mestu

Simptomi

- Micelijske pahljačice se na robu rane razraščajo v eni plasti skorje, na starejših delih raka pa lahko v več plasteh in tudi v odmrli kambialni plasti

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Simptomi

- na maklenu

ker je skorja na maklenu bolj hrapava, je rak manj opazen

rak na maklenu težje opazimo, zato pregled maklena opravljamo natančneje!

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Simptomi

- na maklenu

tudi pravilne
ovalne oblike

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Simptomi

- na maklenu

ker je maklen tudi
zdrav pogosto zavit in
deformiran, sama
deformacija debla
ni zadosti za pozitivno
določitev glive

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Simptomi

- deblo lahko porašča mah, kar še dodatno otežuje zaznavanje raka

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Simptomi

- micelijske pahljačice na maklenu

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Priloga 10:

Jurc D., Ogris N., 2005. Information about the potential quarantine harmful organism. *Eutypella parasitica*, Eutypella canker of maple. Gozdarski inštitut Slovenije, Ljubljana (tipkopis), 10 str.

Information about the potential quarantine harmful organism

Eutypella parasitica
Eutypella canker of maple

IDENTITY

Name:	*Eutypella parasitica* R.W. Davidson & R.C. Lorenz (Davidson and Lorenz 1938)
Synonyms:	None
Taxonomy:	*Diatrypaceae, Diatrypales, Sordariomycetidae, Ascomycetes, Ascomycota, Fungi* (Kirk *et al.* 2001)
General Name:	Slovenian name: javorov rak English name: Eutypella canker of maple, Eutypella canker
Bayer code:	
EPPO A2 list:	not classified
EU classification:	not classified

HOSTS

In the natural areal of fungus in North America, the hosts of Eutypella canker are maples (*Acer* spp.). It is most common on sugar maple (*Acer saccharum* Marsh.) and red maple (*A. rubrum* L.). It occurs infrequently on boxelder (*A. negundo* L.), Norway maple (*A. platanoides* L.), silver maple (*A. saccharinum* L.), black maple (*A. nigrum* Mich.), sycamore maple (*A. pseudoplatanus* L.), and striped maple (*A. pennsylvanicum* L.) (Kliejunas and Kuntz 1974). The report of a finding on *Prunus pennsylvanica* L. in Quebec is not reliable (Sinclair *et al.* 1989).
In Europe, the fungus has been found on sycamore maple (*Acer pseudoplatanus* L.) and field maple (*Acer campestre* L.).

GEOGRAPHICAL DISTRIBUTION

EPPO region:	**Slovenia**
North America:	**USA** (Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York State, Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont) **Canada** (Ontario, Quebec)
E.U.:	**Slovenia**

BIOLOGY

The fungus is a xerophyte and ascomata are inactive under dry conditions. When there are at least 2.5 cm of rainfall and the temperature is above 4 ^{0}C, it takes approximately two hours for ascospores to be produced in the perithecia, which are then dispersed mostly in groups of eight and spread by the wind as a unit (Lachance 1971b, Johnson and Kuntz 1979). The spread of ascospores in stands is relatively poor due to the weight of eight ascospores and to the absence of convection winds in rainy weather, when there are the most favorable conditions for the formation of spores. The greatest number of spores spread in stands at a height of 1.2 m and about 25 m from the source of the spores their number is very small (Johnson and Kuntz 1979). These characteristics for the spreading of spores are likely the reason that more than 91 % of infections begin below 3.7 m above the ground and that the infections within a stand are grouped around an infectious center, i.e. an old Eutypella canker (Kliejunas and Kuntz 1974). The fungus infects trees only through exposed wood tissue, which is usually a dead branch with a diameter of up to 5 cm thick or a wound on the trunk that has not healed quickly (Lachance 1971a). The mycelium spreads from the stump of the branch to the trunk and creates a perennial canker on the trunk, which can then grow for decades along with the tree. One symptom of the disease is the slow increase in an elongated oval canker wound, which does not lose its bark due to the thick hyphal overgrowth in the bark that fixes it onto the wood. The canker grows in height on average 1-2 cm per year, but usually less so in width (Sinclair *et al.* 1989). The fungus spreads into the bark and wood such that it kills the cells in front of the growing hyphae. Five to eight years after the bark dies off, perithecia begin to form in the poorly developed stroma in the bark. At the beginning, the stroma give rise to perithecia in groups that are only a few millimeters wide, but later perithecial necks cover the entire surface of the central part of the canker. Perithecia continually arise in the stroma and, as the old ones die, young ones are formed (Lachance and Kuntz 1970). Therefore spores can always be released when the temperature and moisture conditions are favorable. In certain hosts, conidiomes of the fungus classified in the genera *Libertella* and *Cytosporina* will also usually develop in the stroma and between the perithecia. Conidiogenous cells also produce conidia in two ways. Conidia are not germinal and therefore are not important for spreading the disease (Kliejunas and Kuntz 1972, Glawe 1983). The fungus overgrow the wood underneath the infected part of the bark and cause brown wood rot. Decay is slow, although due to the long duration of the infection the tree often breaks at the infected area. In the central part of the trunk, the fungus grows out of the canker area and colors the wood to within 30-40 cm from the edge of the canker (Gross 1984, Sinclair *et al.* 1989). When the infected trunk lies on the ground, perithecia will develop over the most of the surface of the bark and will produce spores for at least more two years (Johnson and Kuntz 1976).

The fungus in the bark and wood competes well against other organisms; therefore it is easy to isolate it in a pure culture (Davidson and Lorenz 1938). Mycelium in culture is white, cottony, and thick; it also grow quickly, approximately 0.5 cm in radius per day. After five to six weeks, round conidiomata, similar to sporodochium and measuring around 0.75 mm or less, form on the mycelium and are covered with a yellow mass of conidia (Glawe 1983).

DETECTION AND IDENTIFICATION

Symptoms

The infected bark dies off and sinks in slightly, the color of the dead bark becomes darker, usually slightly brownish, and at the edge of the necrosis there is a poorly defined callous swelling. Due to the slow progress of the fungus in the bark the infection is hardly noticeable for the first few years (Figure 1). The necrosis grows together with the growth of the tree and becomes a typical canker. After 5 to 8 years, perithecia start to form in the central part of the canker in the poorly defined stromata. On the surface of the bark there are dark regions with black stromata and the black perithecial necks, which are a few millimeters long and grow out of the bark or stroma (Figure 2).

In some hosts (e.g. *Acer saccharum*), the edge of the canker is often deformed, because the fungus dies off in certain regions of the bark and forms an extensive calloused edge that closes the wound irregularly. In sugar (*A. saccharum*) and red maple (*A. rubrum*), the canker has a strongly elliptical or oblong shape. In sycamore maple (*A. pseudoplatanus*), boxelder (*A. negundo*), and Norway maple (*A. platanoides*), the callous is usually in the form of a regular ellipse, although it can occasionally be an almost perfect circle, without a deformed edge (Sinclair *et al.* 1989).

Figure 1: Early infection with Eutypella parasitica. The bark is sagging slightly, the color has changed, and the edge of the wound is slightly raised.

Figure 2: From 5 to 8 years after die off stromata with perithecia are produced in the bark (black perithecial necks are visible), in the center of the wound is the dead branch through which the fungus has likely infected the tree.

Figure 3: The bark is falling off from the oldest part of the infection, stromata with perithecia are arranged concentrically over most of the surface of the canker.

Figure 4: Strongly deformed trunk with old Eutypella canker; fungi have invaded the exposed wood, which is decomposing.

Stromata with back perithecia or black perithecial necks alone can cover an considerable area of the canker, they are sometimes arranged in a concentric pattern and each circle represents the yearly growth of the fungus in the bark (Figure 3). An important difference between *Eutypella parasitica* and other canker diseases is that the bark which has died off remains fixed to the canker wound for a very long time. First, the bark begins to fall off of the oldest part at the center of the canker and by that point the trunk is already partially deformed or ridged. Old Eutypella cankers completely deform the trunk (Figure 4) and various fungi can then invade the exposed wood causing wood decay and their sporophores can form on the open canker wound. A characteristic sign of infection with *E. parasitica* is an extensive hyphal overgrowth in the bark of the canker wound, particularly at its edge, which forms small thin mycelial fans with a white to slightly cream color (Figure 5). These fans begin to develop in the infected bark two years after the infection has taken hold (Lachance and Kuntz 1966). There is usually one canker per tree, which is generally located in the lower part of the trunk. Stromata with perithecia can also form in or on infected wood without bark, but this is rare (Figure 6) (Kliejunas and Kuntz 1974, Davidson and Lorenz 1938).

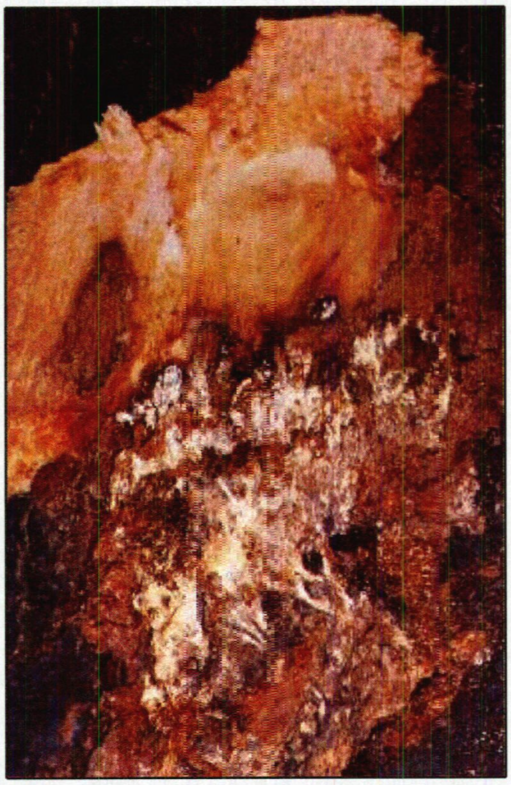

Figure 5: Mycelial fans in the bark are white to cream colored

Figure 6: Stromata with perithecia can also form on wood

Morphology

Perithecia have a radius of 0.6-1.0 mm and their necks are up to 5 mm long; their length is dependent on the depth of formation of perithecia in the bark (Figure 7). Conidia are produced in the bark in variable conidiomes, which can be designated as pycnidium or acervulus by morphology. Conidia are hyaline, bent into a U shape, pointed at the ends, and measure 17-32 × 1.2-1.8 μm (Figure 8). Asci are small with an elongated bottom part (stipe), which measures 10-40 × 1.5 μm, and a widened upper part with ascospores, which measures 32-40 × 6-7 μm. Ascospores are irregular, uni-, bi- or more seriate, one-celled, brown, slightly bent, and measure 8-11×2-2.3 μm (Figure 9) (Davidson and Lorenz 1938, Sinclair *et al.* 1989).

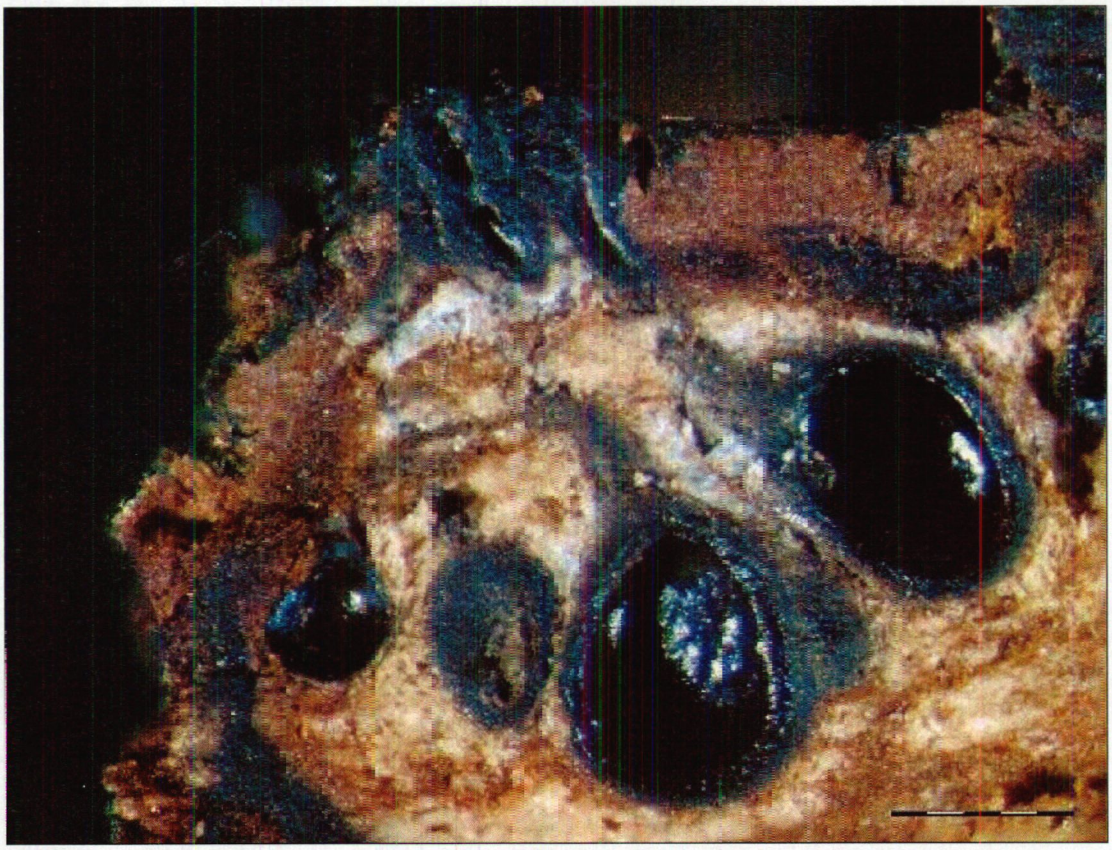

Figure 7. Perithecia and stroma (bar = 0.5 mm)

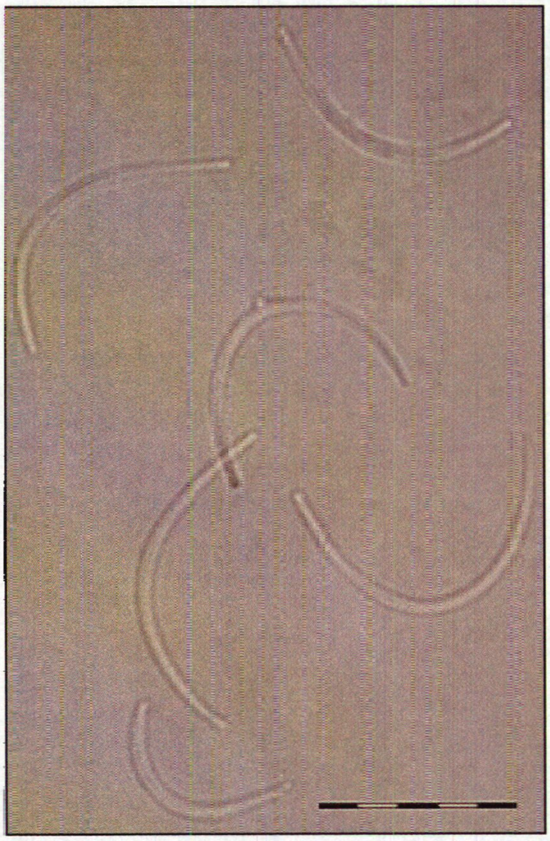

Figure 8: Conidia (bar = 20 µm)

Figure 9: Asci with ascospores (bar = 20 µm)

Detection and inspection methods

An old infection with *E. parasitica* is easy to determine, because there are usually many characteristic signs of Eutypella canker present. The host plant is always maple (*Acer* sp.). The infection is in the form of a regular ellipse or the edge is deformed and the trunk is usually deformed as well. In bark infected with the *Eutypella* canker, mycelium is clearly visible in the form of small fans with a white to cream color particularly at the canker's edge near the healthy bark (the bark is removed with a sharp knife). After five or more years, black perithecial necks grow out of the dead bark; slightly raised black fungal stromata can develop later. These stromata are about 1 cm in diameter, and have shallow crevasses in between.
Perithecia do not form in infections less than 5 years old. At that time the *Eutypella* canker is a flat to slightly sunken elliptical part of the bark, the color has changed and it is almost without a callous edge. Fan-like mycelia are found in the bark and range in color from white to cream.
There are no fan-like mycelia in the bark in infections less than two years old; therefore the presence of fungus young infections can only be proven by isolating the pathogen in a pure culture.

MEANS OF MOVEMENT AND DISPERSAL

The release of ascospores into the air is triggered by precipitation and temperatures above 4 ^{0}C and can occur at any time of the year. The wind usually carries the ascospores a short distance, although they can live a very long time in dry form and can even germinate up to 20 months after drying out (Lachance 1971, Johnson and Kuntz 1979).
The most likely transfer of the fungus occurs through international trade in infected saplings and in infected raw lumber. It is not known whether the fungus forms perithecia on infected wood under suitable conditions.

PEST SIGNIFICANCE

Economic impact
Eutypella canker can lower the production of quality logs of maples since it is found most often below 3.7 m, which represents the most valuable part of tree (Kliejunas and Kuntz 1974). The decomposition of the wood in a tree with Eutypella canker can also spread to the interior of the trunk. Internal damage is usually less than 0.4 m from the outer edge of the canker (Gross 1984a).
The disease often causes death in understorey trees with a trunk diameter less than 7.5 cm, whereas larger trees often break at the site of the canker when there are high winds, heavy snow or sleet (French 1969, Kliejunas and Kuntz 1974).
Eutypella canker is generally found on few maples (under 5 %), although it can reach up to 40% of all maples in certain stands (Gross 1984b). In the Owen Sound region of Ontario, Eutypella canker was found in 7 % of sugar maples. An infected tree loses an average of 12 % total volume and 49 % of its sale volume (*ibid*), which means a loss of about half of its value when sold on the market.
In Slovenia, the Eutypella canker would most likely effect sycamore maple, which represents 2.4 % (7.492.000 m^3) of wood stock in Slovenia and is the 7th most important Slovenian tree species, the Norway maple, which has a wood stock of 121.000 m^3, and the field maple, which has a wood stock of 146.000 m^3 (Brus 2004).
In as much as the disease can also infect other susceptible species of maple, it can

change stands of trees where *A. obtusatum* (wood stock: 43.000 m^3) and the ecologically important Montpelier maple (*A. monspessulanum* L.) and Tatarian maple (*A. tataricum* L.) are a part.

Environmental influence

Maples are an important component of forests in Europe and are found as autochthons throughout almost all of Europe (Figure 10). Maples autochthonous to Europe are: sycamore maple (*A. pseudoplatanus*), Norway maple (*A. platanoides*), field maple (*A. campestre*), Montpelier maple (*A. monspessulanum*), *A. obtusatum*, tatarian maple (*A. tataricum*), and others. In addition to autochthonous maples, other maples such as Silver maple (*A. saccharinum*), boxelder (*A. negundo*), Amur maple (*A. ginnala*), Fullmoon maple (*A. japonicum*), Japanese maple (*A. palmatum*), and others (Brus 2004) are found in Europe in parks, around homes, and in other green areas in urban environments.

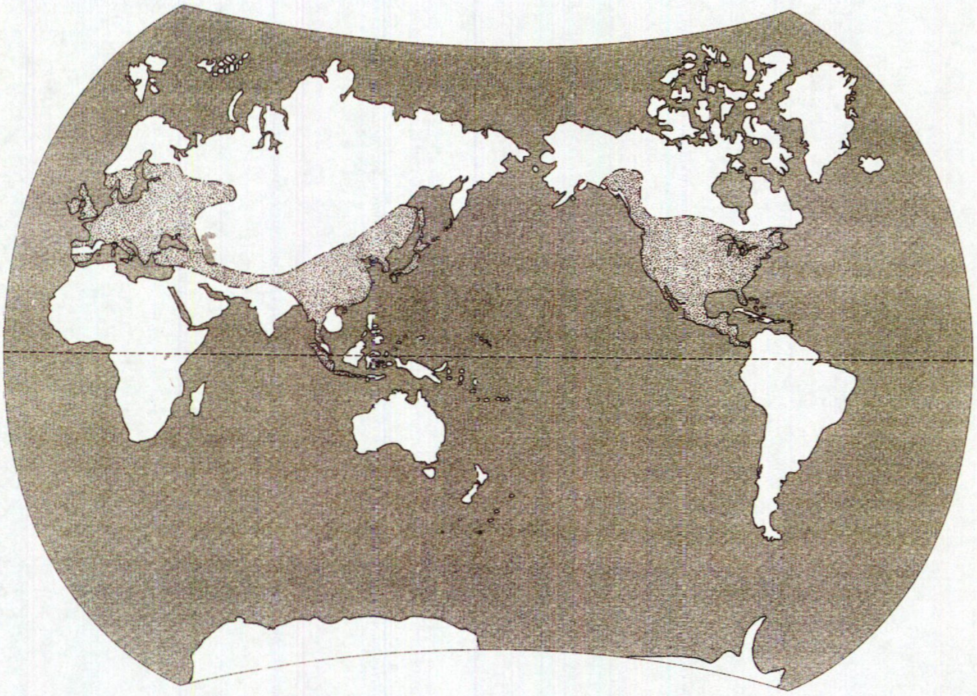

Figure 10: Map of range of maples (Pirc 1994)

Trees with Eutypella canker are less mechanically stable and therefore are more prone to windbreak, which can make whole stands of maples less stable.
Eutypella canker strongly deforms the aesthetic look of maples, which are important component of parks and other parts of the urban environment.

Control

Removing infected parts of the trunk from the stand is recommended in order to control the disease (Johnson and Kuntz 1976, Kliejunas and Kuntz 1974). Removing branches from trees to a height of three meters is recommend for preventing infection in young trees (Kliejunas and Kuntz 1974). In infected decorative trees, cutting out the bark around the entire edge of the canker is recommended and may halt the spread of the fungus (Blanchard and Tattar 1981). However, this proposal is in opposition to the finding that the fungus can grow from dead into living tissue and the success of this method has not been proved (Sinclair *et al.* 1989). Poisoning the tree with Na-arsenite destroys the fungus on the edge of the canker, but does not prevent the formation of ascomata and ascospores (Johnson and Kuntz 1976).

Phytosanitary risk

Eutypella parasitica is dangerous for the sycamore maple (*Acer pseudoplatanus*), Norway maple (*A. platanoides*), and field maple (*A. campestre*) over their entire areal in Europe, as well as for maples in parks, along avenues, and around houses, particularly for the species from North America: *A. saccharum, A. rubrum, A. negundo, A. saccharinum* and *A. nigrum.*
The susceptibility of other autochthonous species in Europe (e.g. *A. monspessulanum, A. obtusatum, A tataricum*, etc.) and other decorative species of maple (mostly Asian) is not known.

PHYTOSANITARY MEASURES

Preventing trade in infected saplings and in raw lumber from infected areas is necessary. Trade in infected debarked lumber and infected cut wood probably has a lower risk of spreading of the disease.

ACKNOWLEDGEMENTS
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Priloga 11:

Jurc D., Ogris N., 2005. Podatki o potencialnem karantenskem škodljivem organizmu. *Eutypella parasitica.* Javorov rak. Gozdarski inštitut Slovenije, Ljubljana (tipkopis), 9 str.

Podatki o potencialnem karantenskem škodljivem organizmu

Eutypella parasitica
javorov rak

ISTOVETNOST

Ime: *Eutypella parasitica* R.W. Davidson & R.C. Lorenz (Davidson in Lorenz 1938)

Sinonimi: **jih ni**

Taksonomska uvrstitev: *Diatrypaceae, Diatrypales, Sordariomycetidae, Ascomycetes, Ascomycota, Fungi* (Kirk et al. 2001)

Splošno ime: Slovensko ime: javorov rak
Angleško ime: Eutypella canker of maple, Eutypella canker

Bayer koda:
EPPO A2 lista: ni uvrščena
EU uvrstitev: ni uvrščena

GOSTITELJSKE RASTLINE

V naravnem arealu glive v Severni Ameriki so gostitelji javorji (*Acer* spp.), predvsem sladkorni javor (*Acer saccharum* Marsh.) in rdeči javor (*A. rubrum* L.). Redkeje okuži ameriški javor (*A. negundo* L.), ostrolistni javor (*A. platanoides* L.), srebrni javor (*A. saccharinum* L.), črni javor (*A. nigrum* Mich.), gorski javor (*A. pseudoplatanus* L.) in pensilvanijski javor (*A. pennsylvanicum* L.) (Kliejunas in Kuntz 1974). Poročilo o najdbi na *Prunus pennsylvanica* L. v Quebecu ni zanesljivo (Sinclair *et al.* 1989).
V Evropi je bila gliva najdena na gorskem javoru (*Acer pseudoplatanus* L.) in na maklenu (*Acer campestre* L.).

RAZŠIRJENOST

EPPO regija: **Slovenija**
Severna Amerika: **ZDA** (Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York State, Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont)
Kanada (Ontario, Quebec)
E.U.: **Slovenija**

BIOLOGIJA

Gliva je kserofit in trosišča so neaktivna v sušnih razmerah. Ko pade najmanj 2,5 mm dežja in je temperatura nad 4 ^{0}C pa v približno dveh urah prične iz peritecijev izmetavati po osem askospor skupaj in veter jih prenaša kot enoto (Lachance 1971b, Johnson in Kuntz 1979). Razširjanje askospor v sestoju je relativno slabo zaradi teže 8 askospor in zaradi odsotnost konvekcijskih vetrov ob deževnem vremenu, ko so najugodnejše razmere za oblikovanje trosov. Največ trosov se širi v sestoju na višini 1,2 m, na razdalji 25 m od vira trosov pa je njihovo število zelo majhno (Johnson in

Kuntz 1979). Opisane značilnosti širjenja trosov so verjetno razlog, da več kot 91 % okužb nastane do višine 3,7 m nad tlemi in, da se okužbe v sestoju grupirajo okoli infekcijskega centra, to je starega javorovega raka (Kliejunas in Kuntz 1974). Gliva okuži drevo samo skozi izpostavljeno lesno tkivo, najpogosteje je to odmrla veja s premerom do 5 cm ali rana na deblu, ki se ne zaraste hitro (Lachance 1971a). Podgobje se razrašča iz štrclja veje do debla in povzroči trajni rak na deblu, ki nato desetletja raste skupaj z drevesom. Značilnost bolezni je počasno povečevanje podolgovate in ovalne rakave rane, iz katere skorja ne odpade zaradi gostega hifnega prepleta v skorji, ki jo pritrjuje na les. Povprečno se rak podaljša 1-2 cm na leto, v širino pa se poveča manj (Sinclair *et al.* 1989). Gliva se razrašča v skorji in v lesu tako, da ubija celice pred rastočimi hifami. Pet do osem let po odmrtju skorje se v njej pričnejo oblikovati periteciji v slabo razviti stromi. V začetku nastajajo strome s periteciji v skupinah, ki imajo premer nekaj milimetrov, kasneje pa prekrivajo celotno površino osrednjega dela raka. Periteciji nastajajo v stromi neprestano, stari odmirajo, med njimi pa se oblikujejo mladi (Lachance in Kuntz 1970). Zato se trosi sproščajo vedno, kadar so temperaturne in vlažnostne razmere ugodne. Pri nekaterih gostiteljih se po pravilu v stromi in med periteciji razvijejo tudi konidiomi, ki jih prištevajo v rod *Libertella* in *Cytosporina,* tudi konidiogene celice proizvajajo konidije na dva načina. Konidiji niso kalivi in nimajo pomena za širjenje okužbe (Kliejunas in Kuntz 1972, Glawe 1983). Gliva preraste les pod okuženim delom skorje in povzroča rjavo trohnobo lesa. Razkroj je počasen, vendar se zaradi dolgotrajnosti okužbe drevo pogosto prelomi na okuženem mestu. V centralnem delu debla se gliva razraste izven območja raka in prebarva les največ do oddaljenosti 30-40 cm od roba rakave rane (Gross 1984, Sinclair *et al.* 1989). Na podrtem okuženem deblu, ki leži na tleh se periteciji razvijejo na veliki površini skorje in proizvajajo trose še najmanj dve leti (Johnson in Kuntz 1976).
Gliva v skorji in lesu dobro konkurira drugim organizmom, zato jo brez težav izoliramo v čisto kulturo (Davidson in Lorenz 1938). Podgobje v kulturi je belo, vatasto in gosto, raste hitro (približno 0,5 cm v polmeru na dan). Po petih do šestih tednih se na njem oblikujejo sporodohiju podobni okrogli konidiomi, prekriti z rumeno maso konidijev, veliki 0,75 mm ali manj (Glawe 1983).

DETEKCIJA IN IDENTIFIKACIJA

Simptomi

Okužena skorja odmre, se rahlo ugrezne, barva odmrle skorje postane temnejša, rahlo porjavi in na robu nekroze nastane neizrazita kalusna nabreklina. Zaradi počasnega napredovanja glive v skorji je prvih nekaj let okužba slabo opazna (slika 1). Nekroza se povečuje skupaj z rastjo drevesa in nastane tipična rakava rana. V centralnem delu raka se pričnо oblikovati periteciji po petih do osmih letih v slabo definirani stromi. Na površini skorje opazimo temne predele s črno stromo, črni vratovi peritecijev, dolgi do nekaj milimetrov izraščajo iz skorje ali iz strome (slika 2).
Pri nekaterih gostiteljih (npr. *Acer saccharum*) je rob rakave rane pogosto deformiran, ker na nekaterih predelih skorje gliva odmre in oblikuje se obsežen kalusni rob, ki nepravilno zarašča rano. Pri sladkornem (*A. saccharinum*) in rdečem javoru (*A. rubrum*) je rak močno eliptičen do podolgovat. Pri gorskem javoru (*A. pseudoplatanus*), ameriškem javoru (*A. negundo*) in ostrolistnem javoru (*A. platanoides*) je običajno rakava rana pravilna elipsa, včasih skoraj popoln krog, rob pa ni iznakažen (Sinclair *et al.* 1989).

Slika 1: Začetna okužba z javorovim rakom. Skorja se je rahlo uleknila, spremenila barvo, rob rane je rahlo dvignjen.

Slika 2: Po 5 do 8 letih po odmrtju se v skorji prično oblikovati strome s peritecji (vidni so črni vratovi peritecijev), v sredini rane je odmrla veja, skozi katero je gliva verjetno okužila drevo.

Slika 3: Skorja odpada na najstarejšem delu okužbe, strome s periteciji so koncentrično razporejeni na veliki površini raka.

Slika 4: Močno iznakaženo deblo s starim javorovim rakom, v izpostavljen les so se naselile glive, ki ga razkrajajo.

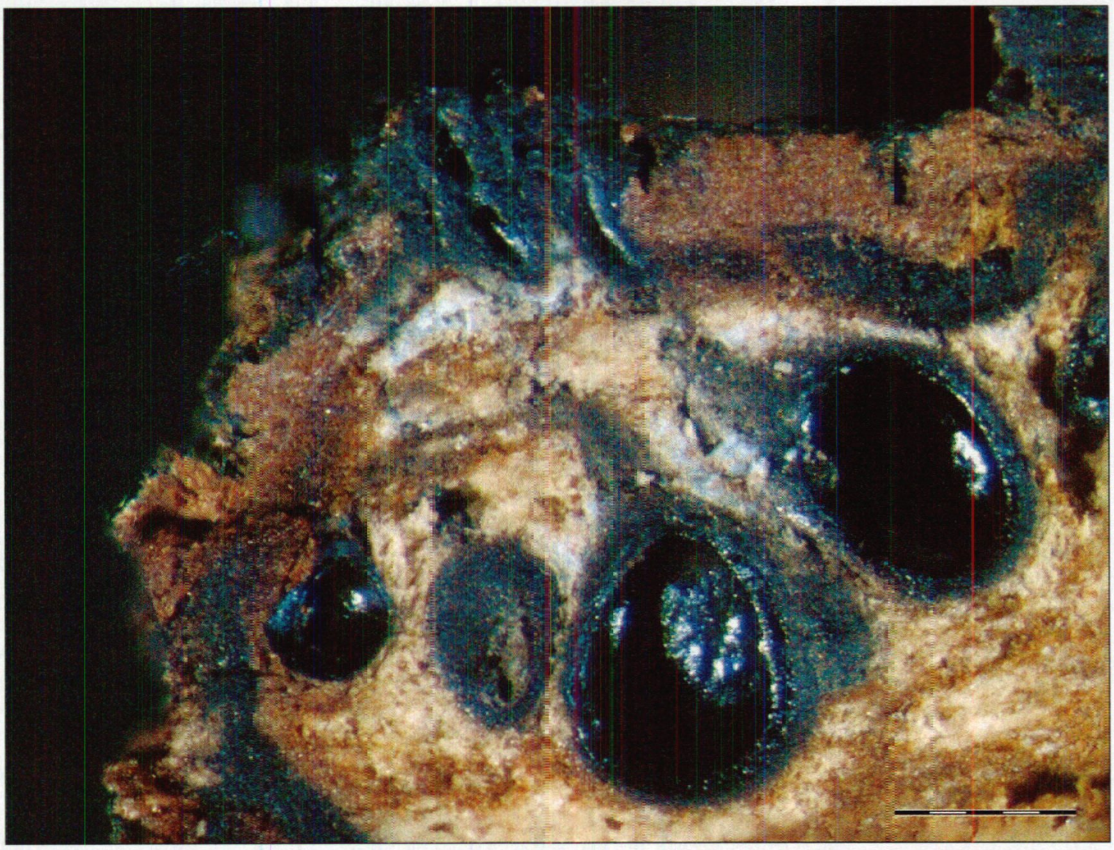
Strome z vratovi peritecijev ali sami vratovi peritecijev lahko prekrivajo obsežno površino raka, včasih so razporejene koncentrično in vsaka skupina nakazuje letni prirastek glive v skorji (slika 3). Pomembna razlika od drugih rakavih bolezni je, da odmrla skorja zelo dolgo ostane pritrjena na rakavi rani. Najprej prične odpadati skorja na najstarejšem delu v sredini raka, takrat je običajno deblo že delno deformirano ali ukrivljeno. Stare rakave rane popolnoma iznakazijo deblo (slika 4), v izpostavljen les se naselijo različne glive, ki povzročajo trohnobo lesa in lahko na odprti rakavi rani oblikujejo trosnjake.
Značilni znak okužbe z *E. parasitica* je obsežen hifni preplet v skorji rakave rane in še posebej na njenem robu, ki je v obliki tankih micelijskih pahljačic bele do rahlo krem barve (slika 5). Te pahljačice se razvijejo v okuženi skorji dve leti po nastanku okužbe (Lachance in Kuntz 1966). Na drevesu je običajno ena rakava rana, najpogosteje je locirana na spodnjem delu debla. Na okuženem lesu brez skorje se tudi lahko oblikujejo strome s periteciji, vendar je to redko (slika 6) (Kliejunas in Kuntz 1974, Davidson in Lorenz 1938).

Slika 5: Pahljačice podgobja v skorji so bele do krem barve

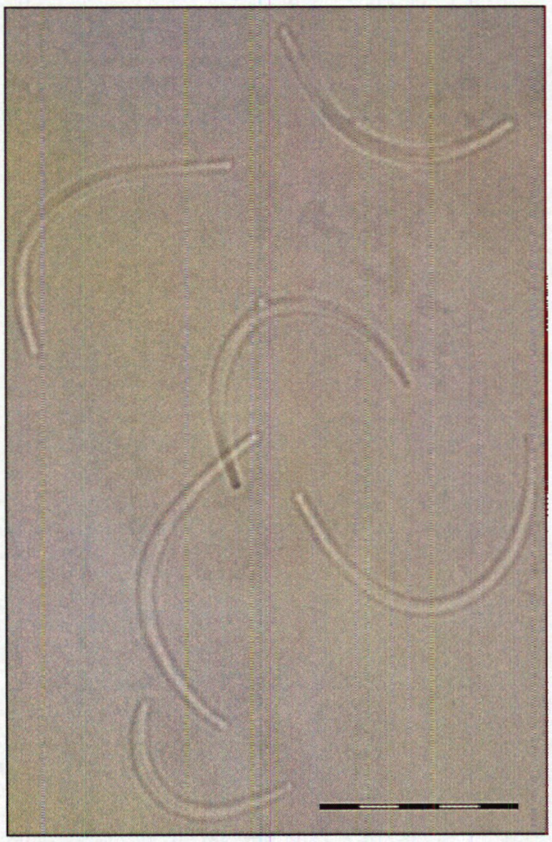
Slika 6: Strome s periteciji se lahko oblikujejo tudi na lesu

Morfologija

Periteciji imajo premer 0,6-1,0 mm, vratovi so dolgi do 5 mm, njihova dolžina je odvisna od globine nastanka peritecija v skorji (slika 7). Konidiji nastajajo v skorji v spremenljivih konidiomih, ki jih po morfologiji lahko označimo kot piknidije ali acervule. Konidiji so hialini, ukrivljeni v obliki črke U, na koncih koničasti in merijo 17-32 × 1,2-1,8 µm (slika 8). Aski so majhni, s podaljšanim spodnjim delom (stipa), ki meri 10-40 × 1,5 µm in širšim zgornjim delom z askosporami, ki meri 32-40 × 6-7 µm. Askospore so nepravilno uni-, bi- ali več- seriatne, enocelične, rjave, rahlo ukrivljene in merijo 8-11×2-2,3 µm (slika 9) (Davidson in Lorenz 1938, Sinclair *et al.* 1989).



Slika 7. Peritecij: in stroma (črta = 0,5 mm)



Slika 8: Konidiji (črta = 20 µm)

Slika 9: Aski z askosporami (črta = 20 µm)

Način inšpekcijskega pregleda

Staro okužbo z *E. parasitica* je enostavno determinirati, ker je običajno prisotnih več značilnih znamenj javorovega raka. Gostiteljska rastlina je vedno javor (*Acer* sp.). Okužba je v obliki pravilne elipse ali pa je rob zvežen, deblo je običajno deformirano. V skorji na rakavi rani in še posebej na njenem robu proti zdravi skorji je dobro opazen micelij v obliki drobnih pahljačic bele do krem barve (skorjo odstranjujemo z ostrim nožem). Na pet in več let odmrli skorji izraščajo črni vratovi peritecijev ali le-ti izraščajo iz rahlo dvignjenih črnih glivnih strom, ki so do enega centimetra v premeru, med njimi pa so plitve razpoke.
Na okužbi, ki je stara do pet let, niso oblikovani periteciji. Takrat je rakava rana sploščen do rahlo ugreznjen elipsast del skorje, skoraj brez kalusnega roba. V skorji je pahljačast micelij bele do krem barve.
Pri okužbi, ki je mlajša kot dve leti, v skorji ni pahljačastega micelija, prisotnost glive lahko dokažemo le z izolacijo patogena v čisto kulturo.

NAČIN GIBANJA IN ŠIRJENJA

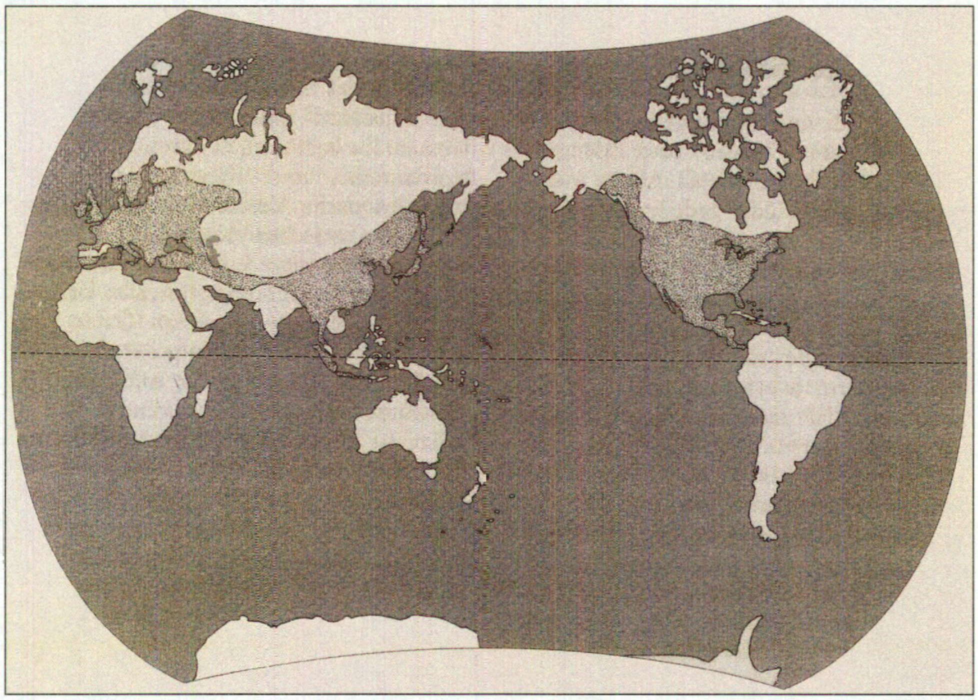
Sproščanje askospor v zrak sprožijo padavine in temperature nad 4 ^{0}C v vseh letnih obdobjih. Veter raznaša askospore običajno na majhne razdalje, vendar so osušene zelo dolgožive, saj jih nekaj kali tudi 20 mesecev po osušitvi (Lachance 1971, Johnson in Kuntz 1979).
Najverjetnejši prenos glive v mednarodnimi trgovini je z okuženimi sadikami in z okuženo neobeljeno hlodovino. Ni znano, ali lahko na okuženem lesu gliva v ustreznih razmerah oblikuje peritecije.

POMEN ŠKODLJIVEGA ORGANIZMA

Gospodarski vpliv
Javorov rak lahko zmanjša proizvodnjo kakovostnih sortimentov javorjev, kajti najpogosteje se nahaja na spodnjih 3,7 m višine, kar predstavlja najvrednejši sortiment drevesa (Kliejunas in Kuntz 1974). Razkroj lesa v drevesu z javorovim rakom se širi tudi v notranjosti debla. Notranja poškodba je navadno od zunanjega roba raka oddaljena manj kot 0,4 m (Gross 1984a).
Bolezen pogosto povzroči odmiranje podstojnih dreves, ki imajo prsni premer manjši kot 7,5 cm. Večja drevesa pa se pogosto prelomijo na mestu raka ob močnejšem vetru, obremenitvi zaradi snega ali žleda (French 1969, Kliejunas in Kuntz 1974).
Javorov rak se na splošno pojavlja na malo javorjih (pod 5 %), vendar pa se v nekaterih sestojih nahaja na tudi do 40 % vseh javorov (Gross 1984b). V predelu Ontaria Owen Sound je bil javorov rak ugotovljen na 7 % sladkornih javorov. Obolela drevesa povprečno izgubijo 12 % skupnega volumna in 49 % prodajnega volumna (*ibid*), kar pomeni polovično izgubo pri prodaji lesa na trgu.
Javorov rak lahko v Sloveniji najbolj prizadene gorski javor, ki ga je v lesni zalogi 2,4 % (7.492.000 m^3) in je slovenska 7. najpogostejša drevesna vrsta, ostrolistni javor, ki ima lesno zalogo 121.000 m^3 ter maklen z lesno zalogo 146.000 m^3 (Brus 2004). V kolikor so za bolezen dovzetne tudi druge vrste javora, lahko pomembno spremeni sestoje, kjer je primešan topokrpi javor (lesna zaloga je 43.000 m^3) in ekološko pomembna trokrpi javor (*A. monspessulanum* L.) in tatarski javor (*A.* tataricum L.).

Okoljski vpliv

Javorji so pomembni sestavni del gozdov v Evropi, saj so avtohtono razširjeni skoraj po celi Evropi (slika 10), to so: gorski javor (*A. pseudoplatanus*), ostrolistni javor (*A. platanoides*), maklen (*A. campestre*), trokrpi javor (*A. monspessulanum*), topokrpi javor (*A. obtusatum*), tatarski javor (*A. tataricum*), in drugi. Poleg avtohtonih javorjev v Evropi so v parkih, ob domovih in drugih zelenih površinah v urbanem okolju še srebrni javor (*A. saccharinum*), ameriški javor (*A. negundo*), mandžurski javor (*A. ginnala*), japonski javor (*A. japonicum*), pahljačasti javor (*A. palmatum*), in drugi (Brus 2004).



Slika 10: Karta razširjenosti javorjev (Pirc 1994)

Drevesa z javorovim rakom so manj mehansko stabilna in zato dovzetnejša za vetrolome, zaradi česar so celi sestoji z javorji manj stabilni.
Javorov rak pomembno kazi estetski videz javorov, kar je pomemben dejavnik pri parkih in drugih površinah v urbanem okolju.

Obvladovanje

Za kontrolo bolezni priporočajo odstranitev okuženih delov debla iz sestoja (Johnson in Kuntz 1976, Kliejunas in Kuntz 1974). Za preprečevanje okužb na mladih drevesih priporočajo obvejevanje dreves do višine treh metrov (Kliejunas in Kuntz 1974). Pri okuženih okrasnih drevesih priporočajo izrezovanje skorje okoli celotnega roba raka, kar bi morda ustavilo širjenje glive (Blanchard in Tattar 1981). Ta nasvet je v nasprotju s trditvijo, da se gliva razraste iz mrtvega v živo tkivo drevesa in uspešnost metode ni dokazana (Sinclair *et al.* 1989). Zastrupljanje dreves z Na-arzenitom je uničilo glivo na robu rakave rane, ni pa preprečilo oblikovanja trosišč in askospor (Johnson in Kuntz 1976).

Fitosanitarno tveganje

Eutypella parasitica je nevarna za gorski javor (*Acer pseudoplatanus*), ostrolistni javor (*A. platanoides*) in maklen (A. campestre) v njihovem celotnem naravnem arealu v Evropi, ter za okrasne javore v parkih, drevoredih in obhišnih vrtovih, predvsem za vrste iz Severne Amerike: *A saccharum, A. rubrum, A. negundo, A. saccharinum* in *A. nigrum.*
Občutljivost drugih avtohtonih vrst javora v Evropi (npr. *A. monspessulanum, A. obtusatum, A tataricum* in drugih) in drugih okrasnih vrst javorov (predvsem Azijskih) ni znana.

FITOSANITARNI UKREPI

Potrebno bi bilo preprečiti promet z okuženimi sadikami in neobeljeno hlodovino iz okuženih območij. Promet z okuženo obeljeno hlodovino in okuženim razrezanim lesom verjetno predstavlja manjše tveganje za širjenje bolezni.

ZAHVALA
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