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The main regions of cork oak decline in Portugal

Maria da Conceição Barros, Filomena Mateus, José Manuel Gomes

Rodrigues..... 1

Abstract: Based on permits issued to cut dead or very damaged trees of *Q. suber*, this work presents the regions where, since 1991, a trend on vitality loss has been noted. The hypothesis of a relation between the presence of podzolic soils and the loss of oak vitality is taken under consideration. Special care should be taken with regard to the human intervention in those zones at tree level or in undercover areas, using the well known conservative technical rules for branch cutting, cork removing, soil mobilisation and cattle breeding

Keys words: map, oak decline, podzolic soils, Portugal

Nouvelles recherches sur l'extension des phénomènes de dépérissement dans les subéraies de Sardaigne

Clizia Sechi, Pino Angelo Ruiu, Antonio Franceschini, Piero Corda 5

Résumé : Les phénomènes de "dépérissement" du chêne liège sont apparus en Sardaigne aux débuts des années 90. Ils se sont manifestés en premier dans les subéraies où les effets négatifs de périodes prolongées de sécheresse se sont ajoutés à des conditions édaphiques peu favorables, un état végétatif précaire et une sylviculture inadéquate. Au cours de la décennie qui a suivi, ces phénomènes se sont progressivement étendus, atteignant même les subéraies aménagées de façon rationnelle. Les recherches entreprises au cours des 4 dernières années ont permis de repérer 60 subéraies en cours de dépérissement réparties dans les principales régions subéricoles de la Sardaigne. Les forêts de chêne-liège les plus affectées sont situées entre 200 et 400 m, sur des sols d'origine granitique, en terrain plat ou sur des versants exposés au sud-ouest. Leurs peuplements, purs et de même âge, ont une régénération naturelle insuffisante ou nulle ; ils sont fortement pâturés et sujets à des infestations répétées de lépidoptères défoliateurs. Les résultats de notre étude seront utilisés pour sélectionner des placettes expérimentales qui reflètent la totalité des subéraies sardes, ce qui permettrait d'une part de créer un réseau régional de surveillance des phénomènes de "dépérissement" et d'autre part d'assurer la mise en œuvre d'éventuelles stratégies d'intervention.

Mots clés : *Quercus suber*, chêne liège, dépérissement, Sardaigne

Current situation of oak decline in Italy and in other European countries

Alessandro Ragazzi, Salvatore Moricca, Irene Dellavalle 13

Abstract: A review on the status of oak decline in Italy and in Europe was carried out. The decline of oak stands was first reported in Italy in 1986, and in Europe (Germany) as early as 1739. In the last 15 years there has been a dramatic situation all over Europe. The oak species most affected in Italy are: *Quercus cerris*, *Q. frainetto*, *Q. pubescens*, *Q. robur*, *Q. suber*; whereas in Europe: *Q. robur* and *Q. petraea*. The decline symptoms common to all oak species in Europe (and in Italy) are: crown thinning, growth of epicormic shoots and bleedings. With regard to the causes, there was always the possibility that the disease was due to multiple abiotic and biotic causes. The main inciting cause was found to be drought.

Key words: oak decline, Italy, Europe, *Quercus* spp.

Methodological approaches to outline control strategies of cork oak decline in Sardinia (Italy)

Antonio Franceschini, Lucia Maddau, Salvatorica Serra, Maria Antonia

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Abstract: The need to define suitable measures in order to overcome the increasing spread of cork oak decline in Sardinia has become of primary importance. To date, 60 declining areas all over the region have been found. However, it is very difficult to outline common control strategies because of the complex etiology of this disease and the remarkable variability of environmental and

sylvo-cultural conditions of the different cork oak stands. Therefore, a research programme with the following objectives has been set up to : 1) characterize the vegetational typologies of declining cork oak stands; 2) create a net of stations, representative for each typology, useful for monitoring the phenomenon; 3) carry out integrated and exhaustive studies of climatic, edaphic, vegetational and sylvo-cultural characteristics in each station; 4) compare the results on the basis of disease evolution. In this paper, the methodology adopted and results of surveys carried out over a four-year period in one station located in North Sardinia are reported.

Key words : decline, cork oak, control strategies, methodology.

A three-year survey of oak decline in Modena (Italy)

Marco Ardizzoni, Paola Nipoti, Giuseppe Amorelli, Silvia Gennari 21

Abstract: *Quercus robur* L. is the typical oak species of Emilia-Romagna region, because it prefers alluvial soils. Decline incidence is about 30% (totalling 500 ha) in the woods of *Q. robur* in Northern Italy. This work consists of a three-year study (1998-2000) on diseased oak trees growing in an urban environment in the city of Modena. The research included the collection of representative leaf samples from the trees chosen in a set of urban localities (Villanova, Fossalta, San Damaso, San Donnino and Viale Amendola). The leaves were subdivided into six classes (0 to V) according to the number of present spots, and into categories according to the damage by phytophagous insects, which in turn were subdivided according to their intensity. Significant analogies among the various localities were recorded. As a conclusion to this three-year study, it is possible to point out some recommendations to limit the spread of oak decline in an urban environment.

Key words : Oak decline, leaf spots, phytophagous insects, urban localities.

Fungi involved in oak decline in an urban area

Marco Ardizzoni, Paola Nipoti, Luciana Di Pillo, Maria Grazia Fantino 25

Abstract Over the last few decades oak decline has affected millions of trees in the northern hemisphere (Europe, United States and Asia). Oak decline was closely investigated over a three-year period (1998-2000). The investigation was carried out in and around Modena and was based on two lines of research (in vitro explants and pathogenicity assays). The results of this three-year study showed the determining role of the laboratory investigations in defining the nature (abiotic or biotic) of the necrotic spots. The pathogenicity assays revealed the virulence of *Chondroplea populea*, which had not yet been widely recognized as a pathogen of the oak.

Key words: oak decline, leaf spots, in vitro explants, pathogenicity assays, *Chondroplea populea*.

Incidence d'endophytes fongiques impliqués dans le dépérissement du chêne-liège

Antonio Franceschini, Lucia Maddau, Francesco Marras 29

Abstract : In a cork oak stand affected by decline in North Sardinia, the incidence of fungal endophytes in canopy organs (leaves, shoots, buds and branches) of both asymptomatic and declining plants, were observed in May and November 2000 and in May 2001. No significant difference was observed in the quantitative and qualitative mycocenose composition of the plants. Among the fungal species isolated, those which may be involved in the disease aetiology were *Biscogniauxia mediterranea*, recurring often by far in all the examined organs, and *Diplodia mutila*. On particular, a seasonal fluctuation of *B. mediterranea* populations has been observed, probably linked to the phenological stage of the host and to the fungus biology. The fungus spends most of its life cycle as endophyte in the aerial plant organs, but it may establish pathogenic relations in the woody organs of the declining trees. In the colonized tissues it produces abundant conidia at the beginning of autumn and afterwards the typical stroma with perithecia containing asci and ascospores. *D. mutila* has never been isolated from the leaves, while its presence was more frequent in the shoots and bark of branches. Although the incidence of this endophyte was always low, it is interesting for decline aetiology to have revealed its presence in asymptomatic and declining plants in a cork oak stand where an high inoculum potential of *B. mediterranea* surely exists.

Key words : endophytes, *Biscogniauxia mediterranea*, *Diplodia mutila*, decline, cork oak.

Molecular characterisation of *Biscogniauxia mediterranea* (De Not.) O. Kuntze strains isolated from declining trees of *Quercus suber* L. in Sardinia
Angela Schiaffino, Antonio Franceschini, Lucia Maddau, Salvatorica Serra 37

Abstract: A collection of Sardinian isolates of *Biscogniauxia mediterranea* (De Not.) O. Kuntze was analysed by means of RAPD-PCR (random amplified polymorphic DNA-polymerase chain reaction), using twenty arbitrary 10-mer primers, in order to detect the genetic variation of the population. Five out of twenty OPA primers were particularly effective in detecting polymorphism. The dendrogram, obtained on the basis of these data by using UPGMA method and Pearson coefficient, showed a high level of genetic variability among the isolates of *B. mediterranea* analysed.

Key words: *Biscogniauxia mediterranea*, *Quercus suber*, RAPD-PCR, polymorphism.

Distribution of *Phytophthora cinnamomi* in cork oak stands in Portugal
Cristina Moreira 41

Abstract: In Portugal, cork and holm oak trees are two important forest species that have been affected by decline disease, mainly during the last two decades. A survey of the presence of *P. cinnamomi* was carried out between 1994 and 1998. The presence of the fungus was assessed at 56 cork and holm oak stands on a range of different sites located in four regions of Portugal (Trás-os-Montes, Ribatejo, Alentejo and Algarve). Soils and roots samples of four trees in each site were assayed for the presence of *P. cinnamomi*. Occurrence of the fungus was related to some local and edaphic factors and to the health conditions of the crowns in each tree. Topographic and exposition site characteristics were also evaluated. Results show evidence that *P. cinnamomi* is widespread in Portugal soils, particularly in the Algarve region where the decline disease presents a high incidence. In this region crown defoliation is correlated with *P. cinnamomi* presence. Shallow and poor soils, with high content of silt and clay are more infested with *P. cinnamomi* than other soils. Cork oak stands situated on slopes facing South can also present the highest frequency of *P. cinnamomi* isolation.

Key words: *Phytophthora cinnamomi*, *Quercus suber*, *Q. rotundifolia*, soil detection, root detection

Distribution of the isolations of *Phytophthora cinnamomi* in the Spanish *Quercus* areas with oak decline disease
Juanjo J. Tuset, Concha Hinarejos, J.J. Mira, J.M. Cobos 49

Abstract: The *Quercus* spp. decline (disease named “seca” in Spain) mainly affects holm and cork oaks. The soil fungus, *P. cinnamomi* is the principal causal agent of the “seca”. Since 1992, its presence has been detected either in the soil or in feeder roots of trees showing serious symptoms of desiccation and death. The General Subdirection for Plant Health of MAPA and the Unit of Mycology of IVIA contributed since 1992 to different research programs and cooperation agreements concerning “seca” disease, the most important part being given to field surveys and laboratory analyses of soil and feeder roots samples. The survey was performed from 1995 to 2000 in woodlands of 17 Spanish provinces where the two mediterranean species, *Q. rotundifolia* and *Q. suber* are predominant. Samples were completed in different seasons of the year, in trees showing symptoms of oak decline and growing in various orographic situations. From a total number of 536 samples, 40 isolations of this fungus were obtained in 10 provinces of the occidental part of Spain. The results of the positive isolation of *P. cinnamomi*, both in the soil and in the roots, from superficial or deep soil layers, showed that the detection of the fungus in the Spanish soil conditions greatly depends of the percentage of humidity of the samples.

Keys words: *Quercus rotundifolia*, *Q. suber*, oak decline disease, *Phytophthora cinnamomi*.

Influence of culture water-solution of five species of Mediterranean *Quercus* in the asexual reproduction of *Phytophthora cinnamomi*
Fermin Cots, Juanjo J. Tuset 53

Abstract: The holm oak, cork-oak and American red oak are damaged by a disease induced by the fungus *Phytophthora cinnamomi*. Infection of the root system occurs mainly via zoospores which production in the soil depends on natural water amount. We studied the effect (possibly by fungistasis) of culture solutions from 5 *Quercus* species on the production of *P. cinnamomi* sporangia and zoospores. Oak seedlings were cultivated 30 days in deionized water. Afterwards,

these culture solutions were employed in three conditions: non sterilised, sterilised 5 mn at 80 °C and concentrated 5 times. Fungus mycelium was placed in petri dishes containing one of the culture solutions during 5-6 days, then the number of sporangia and released zoospores were counted. No difference in the production of these organs was observed in the three types of culture solutions from each oak species .

Key words: *Quercus rotundifolia*, *Q. suber*, *Q. faginea*, *Q. pyrenaica*, *Q. petraea*, *Phytophthora cinnamomi*, cultural solution, sporangia, zoospores

Influence of electrical conductivity due to nitrogen on *Phytophthora* infection in seedlings of *Quercus rotundifolia*
Immaculada Lapeña, Juanjo J. Tuset 57

Abstract: The holm oak (*Quercus rotundifolia*) is damaged by a disease known in Spain as “seca” which is a typical manifestation of “oak decline”. The main parasitic agent of this disease is the fungus *Phytophthora cinnamomi*. Generally, the electrical conductivity (E.C.) of the nutrients solution has not been considered in root rot induced by *Phytophthora* fungi. This is due to a lack of information about the influence caused by the N fertilizer carriers on the development of this diseases. It is more evident in the association *Quercus-Phytophthora*. Therefore, the present study shows the effect produced on the zoospores of *P. cinnamomi* and *P. parasitica* by four different levels of E.Cs. of the soil solution, three of them being due to NH₄NO₃ fertilizer during the infection of the roots of holm oak seedlings. In the experiment, *P. cinnamomi* appeared more susceptible to the toxicity of the fertilizer than *P. parasitica*. Thus, *P. cinnamomi* induced between 60% and 100% of damaged seedlings in all tested E.Cs. and a mortality that decreased from 80% to 20% when the E.C. increased. *P. parasitica* caused a similar injury of seedlings in all the E.Cs. and a mortality varying from 30% to 70% but in this last case no any correlation exists with the E.C. increment. *Q. rotundifolia* appeared to be sensible to *P. cinnamomi* and to *P. parasitica* also. The last species has never been mentioned as a pathogen of *Quercus* spp. In the test, the seedlings have also suffered alterations as a result of the transplantation.

Key words: *Quercus rotundifolia*, *Phytophthora cinnamomi*, *P. parasitica*, oak decline disease, N fertilizer carriers.

La symbiose ectomycorhizienne du chêne-liège dans les plantations portugaises: synthèse des connaissances et perspectives
Helena Machado, Maria Natércia Santos 61

Abstract: The important role of ectomycorrhizal symbiosis on forestry stands ecology, led to the implementation of several studies about this subject, in Portugal. Due to the high levels of cork oak mortality verified during the last two decades, farmers and researchers concentrate their attention on mycoflora associated to this ecosystem, mainly on both population identification and controlled mycorrhization in nursery. However, there is a deficient knowledge concerning symbiosis establishment and maintenance in the field. The main goal of this communication is to appraise the work developed since several decades on mycorrhizal status of cork oak stands in this country, as well as, to establish a proposal on research areas presenting knowledge gaps.

Key words: *Quercus suber*, cork oak, ectomycorrhiza

Insects and fungi involved in oak decline in Italy
Tiberi Riziero, Alessandro Ragazzi A., L. Marianelli, Peverieri Sabbatini,
Pio Federico Roversi 67

Abstract: Field inspections and sampling of plant material attacked by insects and funghi were conducted in oak forests growing at different altitudes, from sea level to roughly 600 m, in Venetia, Tuscany, Marche and Latium. The micro-organisms suspected of causing decline were isolated from the insect bodies by cultures developed in dishes containing the insects, or from water in which the insects were previously immersed. The spread of phytopathogenic fungal agents was ascertained for *Fusarium solani*, *Fusarium* sp. and *Verticillium dahliae* transported by *Scolytus intricatus*, for *Fusarium solani*, *Fusarium eumartii* and *Verticillium dahliae* transported by *Xyleborus dispar*, and finally for *Verticillium* sp. by *Agrilus graminis*. It is likely that the spread of *Diplodia mutila* and *Phomopsis quercina* is attributable to *Sinoxylon perforans* and *S. sexdentatum*. *Coroebus florentinus* seems to be involved in the transport of *Diplodia mutila* and *Verticillium* sp.. There may also be associations between *Chrysobotris affinis* and *Verticillium dahliae*. Linkages may also be found

between *Agrilus biguttatus* and *Fusarium eumartii*, between *Anthaxia millefolii* and *Sporothrix* sp., and finally between *Platyphus cylindrus* and *Verticillium dahliae*.

Key words: fungi, xylophagous insects, declining oaks, Italy.

Contribution à la bioécologie de *Platyphus cylindrus* F. au Portugal

Edmundo M. R. de Sousa, Domitien Debouzie 75

Abstract: The explosion of *Platyphus cylindrus* F. (Col. Platypodidae), observed during the 80/90's in southern Portugal, seems to be related to the current cork oak forest decline. The interactions between forest insect populations and the decline factors affecting the hosts remain partly unknown. Moreover, the population dynamics of *P. cylindrus* is directly related to its larval development phase as well as adult emergence and flying periods. The capacities of survival and selection of the most favourable hosts are determined by these various factors. The results of the bioecological study of *P. cylindrus* in Portugal in a greatly damaged cork oak stand are presented here with the aim to develop control strategies against this pest in the context of current cork oak decline in the Mediterranean region.

Key words: Cork oak, forest decline, xylophagous insect, *Platyphus cylindrus*, bioecology, Portugal

Situation sanitaire de quelques subéraies de l'Ouest algérien : impact des xylophages

Rachid Tarik Bouhraoua, Claire Villemant, Mohamed Anouar Khelil, Sabeha Bouchaour 85

Abstract: Phytosanitary condition of cork oak stands was assessed in 4 national forests in the western part of Algeria. In July 2000 and 2001, among the more than 900 trees examined, more than 60% showed decline symptoms. Oak decline is greater in littoral and mountainous areas which undergo dryer climatic conditions (semi-arid climate). The tree weakening benefits to the xylophagous pest complex from which 17 species were identified. Wood-boring insects induce sometimes the death of the trees and also oak quality decrease. The most injurious species are the Coleoptera *Cerambyx cerdo mirbecki* (Cerambycidae) and above all *Platyphus cylindrus* (Platypodidae). The damage of this last species is greater in littoral stands (77 holes/m²) than in mountainous ones. Several other factors contributed in oak decline, notably drought, frequent forest fires, overgrazing and bad conditions of cork removing.

Key words: Cork oak, Algeria, decline, xylophagous insects, *Cerambyx cerdo*, *Platyphus cylindrus*

Les insectes ravageurs des chênes, *Quercus suber* et *Q. ilex*, en Algérie

Gahdab Chakali, Amel Attal-Bedreddine, Hassina Ouzani 93

Abstract: This work is a review of observations made during the last decade on insect pests of cork oak and holm oak forests in Algeria. Forest managers are worried about periodical infestations of phyllophagous Lepidoptera which represent a latent threat for oak stands. Significant defoliation of *Quercus suber* and *Q. ilex* stands were induced by *Lymantria dispar* and *Ephesia nymphaea*. Frequently, *Euproctis chryorrhoea* and *Orgyia trigotephra* damage cork oak foliage. Attacks of xylophagous insects recently increased in Algeria. Damage of *Cerambyx cerdo mirbecki* and *Platyphus cylindrus* detected in several oak stands seem to greatly contribute to actual oak decline. Acorn production of the last years was reduced by the Tortricid moth *Cydia fagiglandana* and the weevil *Curculio elephas*.

Key words: phyllophagous insect, xylophagous insect, oak, *Quercus suber*, *Quercus ilex*, acorn, Algeria.

Lymantria dispar L. (Lepidoptera, Lymantriidae) en Tunisie: état actuel des connaissances et perspectives de recherche

Mohamed Lahbib Ben Jamâa, Sofiane M'nara, Claire Villemant, Abdelhamid Khaldi 101

Abstract: In Tunisian cork-oak stands, *L. dispar* induces partial or complete defoliation which can extend some years to several thousands hectares. Only few studies however, concern gypsy moth in Tunisia. This paper is an overview of the actual knowledge about the pest in this country.

Gradations follow each other about every 20 years. The general gradation phase, during which defoliation takes place, lasts about 13 years while the latency phase lasts 6 to 7 years. During latency the pest population is at its lowest density level : no defoliation occurs and the pest is only observed in primary infestation sites. In 1999, total absence of defoliation, scarcity and smallness of egg masses as well as their high number of unhealthy eggs suggest that the pest was at the end of its retrogradation phase and had entered into latency. In 1999-2000, aiming at studying and forecasting the population dynamics of the pest and its natural enemies during the latency, we selected 7 study plots considered, according to the bibliography, as potential primary infestation sites.

Key words: *Lymantria dispar*, biology, population dynamic, *Quercus suber*, Tunisia.

Damage evolution and control of *Lymantria dispar* L. in a cork oak forest of southern Portugal
Miguel Serrão 109

Abstract The distribution of cork oak forest in Portugal is mainly situated in the southern part of the country, where *Quercus suber* finds the most adequate climatic conditions for its development. Ranging from the Tagus river valley to the plains of Alentejo, cork oak finds its sanctuary in the region of Ponte de Sôr, where we can find the best cork quality production is found. In the beginning of the 20th century, following the devastating damage caused by phylloxera on vast vineyard areas in the sandy soils south of the Tagus river, the largest existing contiguous plantation of cork oak was planted. The place called Rio Frio represents nowadays more than 3,000 ha of eighty years old trees, managed for cork and livestock production. In this area, the occurrence of moderate attacks of gypsy moth (*Lymantria dispar* L.) is not uncommon. These infestations are usually regulated by the natural enemies complex of the moth. The influence of *L. dispar* on cork oak is well known, particularly in the case of total defoliation which induce a reduction in fruit production, of cork growth and quality, and more important increases the difficulty of cork extraction. Cork oak stands in Rio Frio are managed so that cork harvest is done almost every year in different trees dispersed in the stand, creating a patchy pattern of mixed aged cork trees. Livestock also represents a very important part of this system. The control of severe defoliation by insects is considered very important for the economy of these forest areas. The present work is a case study of *L. dispar* damage monitoring and control methods implementation of an outbreak cycle promoted by abnormal weather conditions. The spread and intensity of damage was analysed over a series of three consecutive years, where different control methods were used. Availability, timing and efficacy of the different methods are discussed.

Keys words: *Lymantria dispar*, field survey, biological control, cork oak, Portugal

Utilisation de *Bacillus thuringiensis kurstaki* 3a-3b dans la lutte contre le bombyx disparate et problèmes posés par les migrations de chenilles
Jean-Claude Martin, Claire Villemant, René Mazet..... 115

Abstract A biocontrol essay with Foray 96B, a new *Bacillus thuringiensis kurstaki* product (BtK), was performed against gypsy moth in spring 2001 in the 5 ha of a South Corsican oak stand. The nearest oak stand was selected as the reference plot. Treatment efficacy was estimated using defoliation index and coprometric measurements. The treatment was done with a Pawnee Piper plane provided with micronair AU 5000 nozzles. It induced a rapid interruption of larval feeding and a high mortality of the pest while the reference plot was entirely defoliated by gypsy moth larvae which then migrated because of starvation. In spite of its high efficacy level (86.67%), Btk treatment did not prevent progressive re-infestation of the treated plot three weeks after treatment nor its subsequent total defoliation. The new biological control strategy we proposes combine BtK insecticide action, which persists during 12 days, with that of diflubenzuron which has a 3 weeks persistence : protection of oak stands against re-infestation of starving gypsy moth larvae could be ensured by a treatment with diflubenzuron of a belt surrounding forest plots treated with BtK. This strategy is appropriate to protect fragmented stands, suburban stands as well as small areas located inside large forests infested by gypsy moth.

Keys words: biological control, *Lymantria dispar*, *Bacillus thuringiensis*, diflubenzuron, defoliation, forest fragmentation, suburban forest

Effets sublétaux de *Bacillus thuringiensis* var. *kurstaki* sur le développement du Lépidoptère *Lymantria dispar* (L.) infecté à différents stades larvaires

Anna Cerboneschi 123

Abstract: Laboratory experiments were conducted in order to investigate whether or not sublethal doses of *Bacillus thuringiensis kurstaki* have any debilitating effects on the fitness of survivors of *Lymantria dispar* L. Larvae of different instars (second to sixth) were exposed during 24 h to *Bacillus thuringiensis* incorporated into artificial diet in order to determine which instars are the most sensitive. The effects of exposure to *B. thuringiensis* on the infected instar, the number and duration of the post-treatment instars, the larval development time, the pupal weight and the emergence of the moths were investigated both for surviving males and females. Some significant effect of the treatment on larval development time and pupal weight were observed ; they differ according to the sex and the instar of the infected larvae.

Key words: *Lymantria dispar* L., *Bacillus thuringiensis kurstaki*, larval instars, development

EAG responses to sex pheromone of *Lymantria dispar* L. males treated with
Bacillus thuringiensis kurstaki
Anna Cerboneschi, Roberto Crnjar, Anna Liscia, Carla Masala, Paolo Solari

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Abstract Understanding of the factors that can influence the success of sex encounter in the gypsy moth *Lymantria dispar*, one of the most important defoliators of cork-oak forest, could improve field techniques, for example, by enhancing sublethal effects of microbial agents employed against this moth. Based on this working hypothesis, we recorded the electrophysiological olfactory responses of the antennae (EAG) to different concentrations of sex pheromone (+)disparlure in males healthy and treated with *Bacillus thuringiensis*, taking into account a variable in population dynamics : the ability of males to recognize pheromone signalling from females. Infections were performed during different larval instars (3rd, 4th, 5th) in specimens from two different localities of Sardinia, by exposition for 24 hours to a diet contaminated with *B. thuringiensis*. Our results showed weak responses of all specimens at the two lowest tested pheromone concentrations (10⁻⁵, 10⁻⁴) while sensitivity strongly enhanced at higher concentrations, were the expected dose-response relationship was present. However, no statistical differences were detected in male sensitivity between untreated and infected specimens of the same locality, regardless of age of larval infection. Nevertheless, we cannot exclude that sublethal effects of microbial agents could be important for a long term program in population control.

Key words: *Lymantria dispar*, EAG, *Bacillus thuringiensis*, infection, Sardinia

Observations on the lepidopterous fauna associated to the cork oak after a
treatment with *Bacillus thuringiensis kurstaki*
Anna Cerboneschi, Pino Angelo Ruiu..... 135

Abstract After a treatment with *Bacillus thuringiensis kurstaki* in a cork-oak forest, the mortality of *Lymantria dispar*, *Malacosoma neustria* and the other Lepidoptera was evaluated. Lepidopterous larvae were collected by beating 3 branches of 5 trees onto a 100 cm square cloth before the treatment and 4, 7 and 15 days after. The living and dead larvae were counted. To complete the mortality data the living larvae were laboratory reared on healthy leaves of cork-oak. The population density of *L. dispar* was estimated by counting the egg-masses on 40 trees before and after treatment. The mortality was also recorded for pupae of surviving individuals and for pupae collected one year after. Treatments against *M. neustria* and *B. thuringiensis* have a great impact on non-target Lepidoptera.

Key words: *Bacillus thuringiensis*, *Quercus suber*, *Lymantria dispar*, non target Lepidoptera

Action de l'extrait de *Melia azedarach* (Meliaceae) sur le développement et la
reproduction de *Lymantria dispar* (L.) (Lepidoptera, Lymantriidae)
Zineb Atay-Kadiri, Amina Semlali, Noufissa Benhsain, Claire Villemant..... 139

Abstract A seed extract of *Melia azedarach* (Meliaceae) was tested under laboratory conditions on gypsy moth larvae (second to fifth instars) fed with cork oak foliage previously soaked in three different concentrations of the extract. Feeding behaviour of the treated larvae is perturbed, particularly in 4th and 5th instars, probably due to antifeedant or repulsive effects of the extract. Reduction in food consumption induced a reduction of larval survival and development duration of the treated instar. Pupal molt of larvae treated at the 5th instar is sometimes prevented. Pupal weight

of males and females treated at their 4th or the 5th larval instar is reduced as well as egg number laid by the females.

Key words: *Melia azedarach*, *Lymantria dispar*, gypsy moth, antifeedant, mortality, larval development

Laboratory and field performance of in vitro and in vivo-reared *Exorista larvarum* (L.), a natural enemy of cork oak defoliators

Maria Luisa Dindo, Marcello Verdinelli, Piero Baronio, Giuseppe Serra 147

Abstract : *Exorista larvarum* (L.) (Diptera: Tachinidae) was reared for one generation on an artificial diet composed of skimmed milk, chicken egg yolk, yeast extract and saccharose. The laboratory and field efficacy of in vitro-cultured *E. larvarum* was compared with that of parasitoids reared on the factitious host *G. mellonella*. The effectiveness of in vitro and in vivo-reared tachinids against the natural host *Lymantria dispar* (L.) was tested in the laboratory. For in vitro-reared *E. larvarum* the percentage of successfully parasitized larvae was 19.8% compared with 22.7% for parasitoids reared on the host. No significant difference was found between the in vitro and the in vivo-reared flies. In a cork oak forest in northern Sardinia (Italy), parasitism of *L. dispar* and *Malacosoma neustria* (L.) by *E. larvarum* cultured in vitro or in vivo was also evaluated. The in vitro-reared females oviposited a significantly lower number of eggs on *L. dispar* larvae. Nevertheless, no difference in percentages of successfully parasitized larvae was recorded between the two rearing methods. No eggs were laid on *M. neustria* larvae by the in vitro-reared females. No puparia formed in *M. neustria* larvae, not even in those exposed to in vivo-reared flies.

Key words : *Exorista larvarum*, rearing techniques, artificial diets, quality control, *Lymantria dispar*, *Malacosoma neustria*

Frequency distribution of *Malacosoma neustria* (L.) egg masses and nests in cork oak forests

Marcello Verdinelli, Pietro Luciano, Giuseppe Serra 151

Abstract: In order to define a reliable sampling method for defoliating moth, data on population density of *Malacosoma neustria* (L.) were collected. Wild *M. neustria* populations were monitored at seven field localities in the major cork oak forests of Sardinia, in the spring of 1998 and 1999. Egg mass and nest location on trees was analysed. An insect preference in laying the egg masses on the East and South facing side of the tree canopy was recorded. Nest distribution on the trees followed the same trend. The spatial distribution among trees was analysed taking into account the fitting of Poisson's, Neyman's and negative binomial mathematical models to the actual distributions. In all localities nests had a gathered distribution among trees while the egg mass location showed a different pattern. Taylor's power law regression was used to determine sample size requirements necessary for estimating population average with two fixed levels of precision ($D = 0.10$; $D = 0.25$). At low egg mass density condition a high number of trees should be observed ($D = 0.10$; $\bar{x} = 0.5 \div 1$; $n = 370 \div 223$). Using Taylor's power law parameters at a precision level $D = 0.25$ with a population density of 1 egg mass per tree, it is necessary to examine 36 trees. The results obtained encourage us to suppose that the observation of a limited part of the tree offers reliable data to estimate the pest population density.

Key words : spatial distribution, sampling methods, sample size

Spatial distribution and sampling of *Tortrix viridana* L. egg-clusters

Giuseppe Serra, Pietro Luciano, Andrea Lentini, Gianni Gilioli 155

Abstract: The spatial distribution of the egg-clusters of the green oak leaf roller moth, *Tortrix viridana* L., was studied in Sardinia on deciduous oak stands during 1997-99. A sampling design to estimate the population density in extensive sampling survey based on the Kuno's technique was reported.

Key words : aggregation, sample size, sampling methods, *Tortrix viridana*, *Quercus pubescens*

Gall inducing insects associated with oak trees (*Quercus* spp.) in Portugal

Maria Lurdes Inácio, Pedro Naves, Monica Moreira, Edmundo Manuel

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Abstract A total of 240 gall midge species (Diptera: Cecidomyiidae) are known from the

Iberian Peninsula, among which 118 were reported from Portugal. However, only six of them have been recorded associated with the cork oak *Quercus suber* L. or the holm oak *Quercus ilex* L. (= *Q. rotundifolia* Lam.). After the death of Tavares in 1934, practically no one studied the gall midge fauna in Portugal, whereas in Spain and other European countries several papers concerning this group were published since. The gall wasps (Hymenoptera, Cynipidae) are another important group of gall inducing insects, with 86% of the species affecting different *Quercus* species. In this work, we report an intense attack of the gall midge *Dryomyia lichtensteini* (F. Löw) on green oak in the Alentejo region. A brief review of the available literature of the gall midge and gall wasps associated with *Quercus* spp. in Portugal is also presented.

Key words: *Dryomyia lichtensteini*, Cecidomyiidae, Cynipidae, Portugal, *Quercus*.

Effect of insect predation on the quality and storage conditions of acorns of cork oak (*Quercus suber* L.)

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Abstract: The present study focused on the importance of insects in damaging *Quercus suber* acorns both immediately after harvesting and during storage (0°C), and on assessing the influence of exposing acorns to heat treatment, i.e. water bath at 45°C, on insect survival and seed performance. Seed performance was assessed by analysing moisture content and embryo electrolyte leakage on recently treated acorns and by determining seed germination and seedling dry mass from stored acorns. The percentage of insect attacked acorns was high but differed according to harvest periods, averaging 56% in November and 33% in December. Damage due to larvae feeding activity persisted during storage, particularly for the weevil *Curculio elephas*. On the other hand, heat treatment proved to be very efficient in controlling insects, accounting for 100% of larvae mortality. Our results evidenced that heat treatment does not affect embryo quality, seed germination and seedling growth of *Q. suber*.

Key-words: acorns, insect damage, storage, heat treatment, *Quercus suber*.

Importance des milieux aquatiques temporaires associés à la subéraie des Zaërs (Maroc)

Fatima Agtay..... 169

Abstract: Because it undergoes a semi-arid climate, the cork-oak forest of the Zaërs region is actually in bad condition especially at Benslimane near the town of Casablanca where forest undergoes great human pressure. This condition however is locally improved by the presence of temporary pools named dayas. By retaining water, dayas enable the forest to take advantage of a prolonged humidity supply ; they also contribute notably in enriching the fauna of the forest ecosystem. This study is focused on the contribution of the temporary pools of the Ben Slimane-Sidi Bettache region to the biodiversity of the cork-oak forest.

Key words: cork-oak, forest ecosystem, temporary pools, poolside fauna, arthropods, Ben Slimane, Zaër region, Morocco.