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La diffusion du complexe du dessèchement rapide de l'olivier (CDRO) dans les Pouilles: une apparente contradiction par rapport au modèle agricole

Margherita Ciervo

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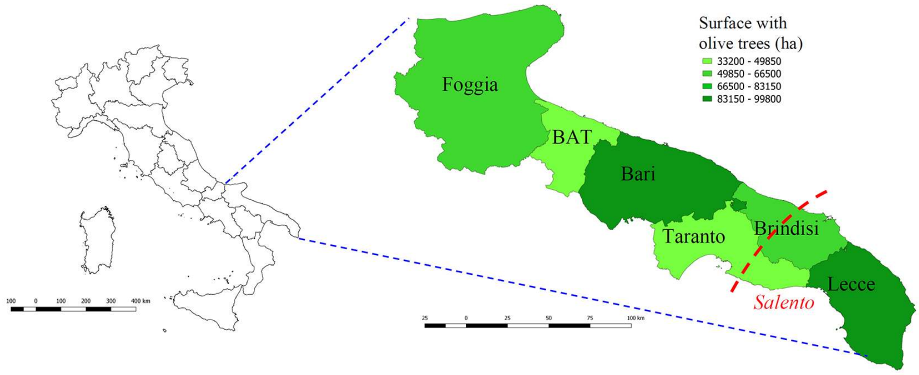
Introduction

1 The olive quick decline syndrome (OQDS), that is to say the olive trees with leaf scorch and die-back of twigs and branches, has affected here and there southern Apulia, particularly the Salento peninsula, that is the province of Lecce and the southern zones of the Brindisi and Taranto provinces (figure 1).

Figure 1. The Apulia map with the Salento peninsula location, showing the surface with olive trees (hectares), 2012.

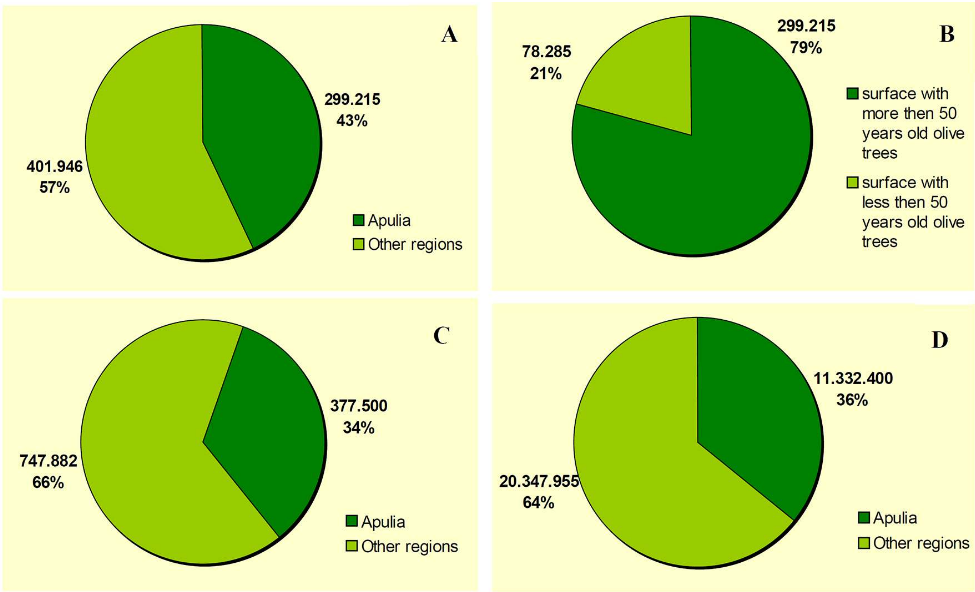


Source: own map on data by www.istat.it

2 The olive trees rapid decline has been ascribed to a range of causes such as the fungi, the leopard moth (*Zeuzera pyrina*) and the *Xylella fastidiosa* (*xf*) bacterium, in addition to the reduction of cares such as the pruning of the parts attacked by parasites. We have chosen this case study because of the potential territorial impacts and its relevance on cultural, geoeconomics and geopolitical level. Apulia is the land of secular olive trees (figure 2ab) that characterize the landscape and the economy. It is the first on the national level in terms of surface with olive trees (figure 2c) and production of olives and olive oil (figure 2d). As for the *xf*, it is a quarantine bacterium and its diffusion represents a potential threat for European countries.

3 The aim of this research is to verify if there is a correlation between the ways of land use, that is to say the agricultural model, and the OQDS diffusion in order to offer some elements of reflection to the interpretation of the phenomenon and, consequently, to the current debate.

Figure 2. Apulia, 2012: the surface (hectares) with half-century olive trees on the national level (A) and on the regional level (B); the surface (hectares) with the olive trees (C); the olive total production (quintal) on the national level (D).



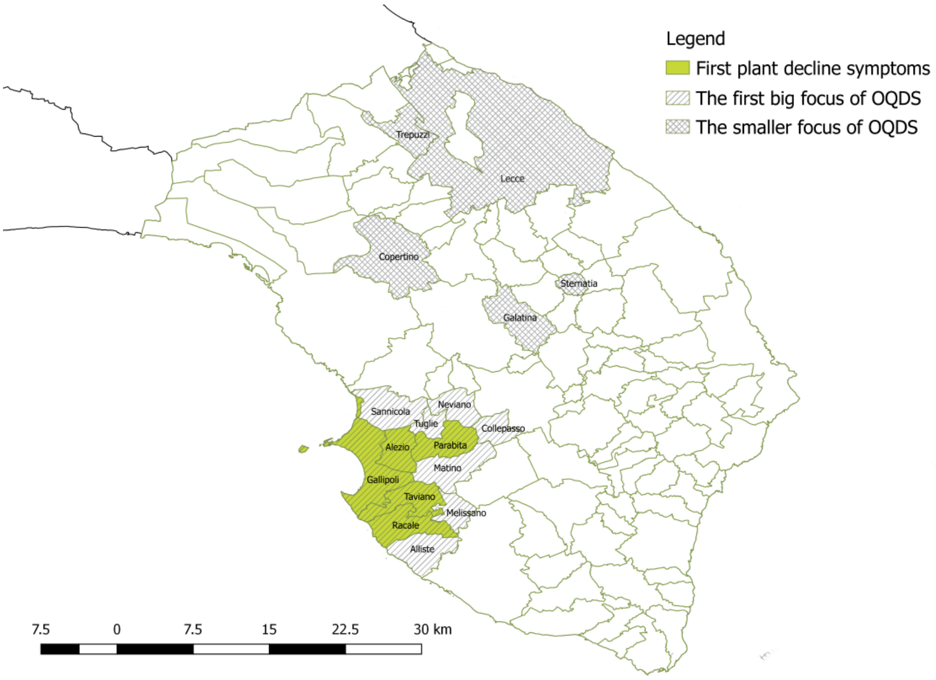
Source: own figure on data by www.istat.it

Background

The diffusion of OQDS

4 In the western Salento peninsula, olive trees with leaf scorch symptoms and die-back of twigs and branches have been observed since 2008 in the municipalities of Gallipoli, Racale, Alezio, Taviano and Parabita in the province of Lecce. In 2014 a big focus has been found in the Gallipoli area – around 23,000 hectares (of these 7,000 ha with olive plants), referring to 12 municipalities (Alezio, Alliste, Collepasso, Gallipoli, Matino, Melissano, Neviano, Parabita, Racale, Sannicola, Taviano and Tuglie) – and other smaller focuses have been located in the municipalities of Trepuzzi (7 ha), Lecce (30 ha), Copertino (5 ha), Galatina (4 ha) and Sternatia (1 ha) (figure 3).

Figure 3. Salento: the municipalities with the first plant decline symptoms (2008) and the olive trees decline focus (2014).



Source: own map on data by Procura della Repubblica di Lecce, 2015 and Apulia Region, 2014

5

6 They have been initially ascribed to the anthracnose of olive plants, while successively to a range of causes (as fungi, leopard moth and *xf*) and called “olive quick decline complex” (Apulia Region, 2013). Nevertheless, the attention has been concentrated on the *xf* even if some studies asserted that “we were unable to determine if *xf* is or is not the causal agent of OLSD, olive leaf scorch disease” (Krugner *et al.*, 2011, p. 3) and others showed that *xf* was not always present in the sample collected from trees with symptoms or that the quick decline was associated with different fungal species (Carlucci *et al.*, 2013ab, 2015; Giannozzi *et al.*, 2013; Nigro *et al.*, 2013). In addition, there are “attestations that fungi can cause individually the decline of trees” (EC, 2014a, p. 7). On the other hand, the empiric evidence reveals that around 500 olive trees with decline symptoms have been sprouting again after biological control measures of fungi pathogens (http://temi.repubblica.it/micromega-online/salviamo-gli-ulivi-della-puglia/?printpage=undefined).

7 Moreover, some more recent studies conducted in California on olive trees exhibiting leaf scorch or branch die-back symptoms have shown that they are not well correlated with *xf* presence. In fact, “only approximately 17% of diseased trees tested positive for *X. fastidiosa* by polymerase chain reaction, and disease symptoms could not be attributed to *X. fastidiosa* infection of olive in greenhouse pathogenicity assays”, as well as the “mechanical inoculation of *X. fastidiosa* olive strains to olive resulted in infection at low efficiency but infections remained asymptomatic and tended to be self-limiting” (Krugner et *al.*, 2014, p. 1186).

8 The *xf*, a bacterium known in America, is a quarantine agent in Europe that “has been *previously reported* in the Mediterranean region, but *did not spread* probably because of the lack of a vector” (Carlucci *et al.*, 2013b). The *xf* is in the European and Mediterranean Plant

Protection Organization list (A1-EPPO), and its vector in the Salento peninsula has been identified with the *Philaenus spumarius L.* so-called "*Sputacchina media*" (Saponari *et al.*, 2014). However, according to EFSA (2015, pp. 116), "all xylem fluid-feeding insects in Europe are considered to be potential vectors [...] Additionally, only limited data are available on vectors' capacity to survive long-distance transportation on their own in vehicles [...] and on vectors' autonomous dispersal capacity". Much uncertainty also exists regarding the potential host plants "as a wide range of European wild plant species have never met the bacterium and it is not known whether they would be hosts, and, if so, whether they would be symptomatic or asymptomatic".

The so called "*Xylella* emergency"

9 So, in 2013, the Apulia Region decreed (DGR n. 2023 on 29 October) *emergency measures* for prevention, control and eradication of *xf*, *without scientific evidence* (about the bacterium, host plants, epidemiology and vectors), according to a reductionist and a mechanistic approach, in addition to a very strong suspicious and inconsistent process, characterised by a sort of "short-circuit" between science, information and policy (Ciervo, 2015). The Apulia Region demanded (DGR n. 1842 on 8 September 2014) and obtained (on 10 February 2015) the declaration of the *state of emergency*, with the nomination of an Extraordinary Commissioner. In Italy, it was the first time that the emergency state was declared because of plant health. The Commissioner drew up a plan taking into account the regional decisions substantially confirmed by the European Commission (2014/87/EU, 2014/497/EU, 2015/789/EU) in order to prevent the *xf* diffusion in the EU countries.

10 The plan provided for the demolition of the trees (infects, potentially infects and not infects), a very large use of pesticides and the prohibition to plant the host plants (olive trees included), also if "*there is no record of successful eradication of Xf* once established outdoors due to the broad host range of the pathogen and of its vectors" (EFSA, 2013, p. 25) and "when infections are predominantly or exclusively primary [...] insecticide applications on the crops are *not very effective*" (Purcell, 1979). In addition, "the intensive use of insecticide treatment to limit the disease transmission and control the insect vector may have direct and indirect consequences for the environment by modifying whole *food webs* with cascading consequences, and hence affecting *various trophic levels* [...] In addition, large-scale insecticide treatments also represent risks *for human and animal health*" (EFSA, 2015, p. 66).

11 Moreover, if we consider that the Extraordinary Commissioner declared one million of infected olive trees only in the province of Lecce, that is to say approximately one over ten (http://corrieredelmezzogiorno.corriere.it/lecce/cronaca/15_marzo_03/milione-ulivi-salentini-malati-xylella-colpisce-10percento-piante-ac37e2a6-c19a-11e4-b25e-6a1aaa2c8bc6.shtml), we can imagine the devastating and irreversible effects of the plan implementation on the landscape, ecosystem, local economy and human health, as well as the deterritorialisation process, which means the destruction of the traditional territorial relationships and the transformation of the population-resources relations (Raffestin, 1981; Turco, 1988). This is the reason why the plan was strongly contested by a large part of peasant, environmental and medical associations, NGOs, municipalities, and raised a considerable popular mobilisation. It has also been a topic of the "Agro-mafia" report (Eurispes *et al.,* 2015) among others, of parliamentary agenda and subject of an investigation. The plan was stopped by the Justice on 18 December 2015: the olive trees

were sequestrated and their destruction forbidden. Today, some experimental scientific projects to face the OQDS based on sustainable environmental methods are being developed by the Floriculture Research Centre of Caserta (http://centrostudiagronomi.blogspot.it/), the Universities of Basilicata (Xiloyannis *et al.*, 2015), Bologna (www.trnews.it) and Foggia (http://corrieredelmezzogiorno.corriere.it/lecce) and a lot of other experimentations against to OQDS are producing very good results.

The state of the art: the main positions in the scientific field

12 In the scientific field, two main positions stand out. The first, that is to say primarily the current position of CNR-National Researches' Council, ascribes the leaf scorch symptoms and die-back of twigs and branches to *Xylella fastidiosa*. So, in this case the objective is to eradicate the bacterium regardless of understanding the real incidence of *xf* in the phenomenon. For example, a CNR researcher has declared that the tests of pathogenicity have a great importance for the science, but that they are absolutely irrelevant for the control plans because the dangerousness of *xf* is already known and demonstrated (Mattedi, 2015). Currently, there are two international projects on this theme coordinated by IPSP-CNR (Institute for plant sustainable protection-National Researches' Council) and funded by the H2020 UE Program: the Pest Organisms Threatening Europe-POnTE (www.ponteproject.eu) with a EU contribution of 6,850,000 euro (http://cordis.europa.eu/project/rcn/204627_en.html) and the *Xylella fastidiosa* Active Containment Through a Multidisciplinary-Oriented Research Strategy- *Xf*-Actors (www.xfactorsproject.eu/), with a EU contribution of 6,903,000 euro (http://cordis.europa.eu/project/rcn/20602dica7_en.html). These researches satisfy the European Commission's request to eradicate the *xf* (EC, 20114bc, 2015). The "*Xf*-Actors", in particular, is the first research project in Europe entirely devoted to the research on the bacterium *Xf;* it is composed of a large consortium, involving the University of Bari and other 28 Partners and Research's Institutions. Its main purpose is "to accomplish researches and innovation actions to improve the prevention, early detection and control of *Xylella fastidiosa* under different phytosanitary conditions (EU Implementing Decision 789/2015: "pest-free areas", "buffer zones" and "infected zones")" as well as the "identification of genes involved in the host-response which may be used to set specific breeding and genetic improvement program". To eradicate *xf*, other different solutions have been proposed: the phage cocktail composed of virulent (lytic) phages (Das *et al.*, 2014, 2015); the substitution of the traditional olives with cultivar more resistant as, for example, the FS-17 CNR patented cultivar, known as "*Favolosa*" (www.cnr.it/it/comunicato-stampa/7411/scoperta-un-altra-cultivar-di-olivo-resistente-alla-xylella); the study of the vectors and modalities to stop them (Bosco, 2014). Moreover, some researchers extend their analysis to prevent the *xf* diffusion to the agricultural practices (Xiloyannis *et al.*, 2015).

13 The other main position ascribes the leaf scorch symptoms and die-back of twigs and branches not necessarily to the *Xylella fastidiosa* but to some different biological and agronomic causes as fungi (Carlucci *et al.,* 2013a, 2015), the decline of agronomic practices and the abuse of chemical products (Perrino, 2015). According to Perrino (2015), former Director of the Vegetable Genetic Institute of CNR- Bari, the development of pathogens could be the effect and not the cause of the illness of olive plants, which have become more vulnerable for the reduction of biodiversity due to the industrial agriculture and, thus, to the abuse of chemical products, herbicides, etc., as well as to the negative

climatic factors (humidity, temperature, thermal excursion) and the water stress. In this case, the research's aim is to treat the olive trees suffering from OQDS. For example, the University of Foggia (Department of Environmental, Food, Agrarian Science) and the University of Salento (Department of Environmental and Biological Sciences and Technologies), together with the Farmers' Confederation (COPAGRI-Lecce), have developed a project to identify environmentally compatible products in order to reduce or remove the pathogen charge referring both to fungi and bacteria that cause the OQDS, as well as to stimulate the plant resistance and the vegetative recovery (www.senato.it/application/xmanager/projects/leg17/attachments/documento_evento_procedura_commissione/files/000/002/523/25_marzo_COPAGRI.pdf).

14 In 2015, an experiment with olive plants affected by OQDS has been conducted in order to evaluate the possibility to control the symptomatology with products and good agronomic practices. The results confirm the capacity of the plants to react to the pathogenic attacks without threatening the production, thus that the productivity of olive plants is not compromised by the presence of *xf*. This means that it is possible to hypothesize the cohabitation of the olive with the bacterium and the territory (Carlucci *et al.*, 2016). In this context, there are different projects coordinated or participated in by the University of Foggia and funded by the Apulia Region: the eziologic microorganism of OQDS, implementation of methods for monitoring and control of pathology by microorganism and agronomic techniques – Eziocontrol; the monitoring of *xf* and OQDS – Mix Codiro; the application of strategic protocols for the control of OQDS – Aprocodiro; the comparative study concerning the efficacy of organic products for the control of OQDS in the focus area of *xf* – Biocoxy. Other projects look directly at the agricultural typology as a possible solution. This is the case of the symbiotic agriculture, a "new" practice focused on natural relations and processes that respect the microbiota of soil and plants and use it to reactive the vitality, health, biodiversity and fertility of the soil and, thus, the natural resistance of the plants to the attack of pathogens. In this regard, a project based on some applications of a mix of beneficial bacteria and fungi applied to olive plants with OQDS in 41 farms (total of 64 hectares), localised in 23 municipalities in the focus area, has produced a vegetative recovery (www.tagpress.it/ambiente/contrasto-xylella-codiro-agricoltura-simbiotica-20170123; http://www.zooassets.it/micosat-f-olivo-contro-la-xylella/).

15 What is thus the core problem? *Xylella fastidiosa* or the leaf scorch symptoms and die-back of twigs and branches? This is a crucial question for two basic reasons: first, the solution depends on a correct vision of the problem, otherwise there is a risk to worsen the situation; second, we debate with common goods and public resources, in other words a territory that suffers the consequences of the phenomenon and undergoes the decisions adopted by institutions in the ecological and socioeconomic fields; thirdly, the researches are supported by public capital. We therefore propose data and reflections that could be useful to the current debate.

The correlation between land use and plant disease

16 In the scientific literature, the poorness of the soils receiving chemical products and, thus, the major vulnerability of plants to the pathogens and diseases has been well known for long a time (Altman, Campbell, 1977; Mekwatanakarn, Sivasithamparam, 1987;

Drinkwater *et al.*, 1995). As regards herbicides and specifically the glyphosate, a broad-spectrum herbicide widespread on the global scale, several problems have been observed: a significant decrease in macro and micro nutrients in leaf tissues and in photosynthetic parameters (Saes Zobiole *et al.,* 2010), its interaction with plant nutrient availability (to keep plant health), plant pathogens and disease development in crop plants, as well as development of glyphosate-resistant weeds (Yamada *et al.*, 2009). About problems of plant nutrition and disease linked to glyphosate use, we point out the Special Issue of European Journal of Agronomy (Kremer *et al.,* 2009).

17 Some studies have established a correlation between plant disease, spread bacteria and the use of herbicides, referring also to *xf*. Expressly, "various diseases caused by *X. fastidiosa* are referred to as 'emerging' or 'reemerging' diseases as glyphosate weed management programs for their respective crops have intensified. These diseases (Pierce's disease of grapevine, plum scorch, almond scorch, citrus variegated chlorosis, coffee blight, citrus blight, alfalfa dwarf, pecan decline, etc.) are characterized by a loss of vigor, slow decline, micronutrient deficiency, and reduced productivity. The pathogen is an endophytic bacterium that colonizes xylem tissues and restricts nutrient translocation when plants are stressed [...] Glyphosate stimulation of fungal growth and enhanced virulence of pathogens such as *Fusarium, Gaeumannomyces, Phytophthora, Pythium,* and *Xylella* can have serious consequences for sustainable production of a wide range of susceptible crops and lead to the functional loss of genetic resistance [...]. Nutrient balance is important because each element functions as part of a delicately balanced, interdependent physiological system with the plant's genetics and the environment" (Johal, Huber, 2009, pp. 147-150). With regard to olive trees and their disease in California, Krugner *et al.* (2014, p. 1186) affirm that "*X. fastidiosa* did not cause olive leaf scorch or branch dieback but olive may contribute to the epidemiology of *X. fastidiosa*-elicited diseases in California. Olive may serve as an alternative, albeit suboptimal, host of *X. fastidiosa*. Olive also may be a refuge where sharpshooter vectors evade intensive area wide insecticide treatment of citrus, the primary control method used in California to limit glassy-winged sharpshooter populations and, indirectly, epidemics of Pierce's disease of grapevine".

18 As regards specifically the OQDS in Apulia, some experts sustain that among the main causes of the olive trees' weakness there is the ten-year overdose of herbicides and especially glyphosate that make plants more vulnerable to pathogens (Perrino, 2015). On the other hand, the Italian herbicide resistance working (GIRE, 2016) has recently detected the presence of glyphosate resistant weeds in the olive tree grove in the Lecce province. Indeed, the Chamber of Deputies Agriculture Commission (7-00210, on 19 December 2013) recorded in the focus zone the olive decline symptoms spread here and there, with a larger presence of diseased plants in soils where herbicides (especially the Roundup by Monsanto with glyphosate) and fungicides are used in huge quantity than in the fields cultivated according to organic methods (www.camera.it/leg17/410?idSeduta=0141&tipo=atti_indirizzo_controllo). In that respect, already in 1974 in the Gallipoli rural area (province of Lecce) olive plants damaged by herbicide were observed. In this case the herbicide was the Bromacil used in a Citrus orchard that, absorbed by roots, caused the consociated Olive trees the following symptoms: vein yellowing of leaves followed by apical desiccation, abscission and defoliated twigs. The dose used was 4,5 kg/ha and the observed damages regarded also olive trees at a distance of more than seven metres from the treated area (Luisi, De Cicco, 1975).

19 Nevertheless, a huge amount of chemical products is used in the monocultures and in the intensive agriculture. But in the Apulia Region these are localized in the North (respectively in the Foggia and Bari provinces), which has not been affected by the phenomenon. Furthermore, we have learned of the presence in the Lecce province, at least, two experimental fields' typologies: to verify the efficacy of new chemical products against the anthracnose of olive trees and to implant the GIPP Project by Monsanto in order to control the weeds by herbicides in olive orchards.

Methodology

20 The methodology is based on the inductive approach, the direct and indirect observation of the phenomenon by official data. The data concerning the olive trees rapid decline phenomenon and *xf* diffusion have been gleaned by the institutional reports and documents (on European, national and regional level), as well as by the official Apulia region website (http://sit.puglia.it/portal/portale_gestione_agricoltura/ViewMenuPortletWindow?action=2&idsezione=542&nomesezione=Ulivi%20-%20Xylella%20Fastidiosa&paginacms=null). So, in order to verify the possible correlation between land use and OQDS diffusion we have observed on the regional scale the distribution of the chemical products and on the provincial scale the distribution of the organic agricultural lands. To this aim, we have used the official statistical data of the Italian Statistics Institute (ISTAT). Referring specifically to the distribution of chemical products, we have considered the provincial level and the 2003-2015 period, due to the data availability. We have explicitly and repeatedly asked for a data elaboration on the local scale, the municipal level, but the ISTAT answered as a first step that these data need a specific elaboration, as a second step that the elaboration is not possible because "there is not the exact representativeness of municipalities" and as a third step that "the data on municipal level are not available". These data could also be obtained from the sales books or the treatments books regarding chemical products. But because they are private documents, the access to these documents is subordinate to a voluntary act of the sellers or the farmers. So, this condition precludes *a priori* the possibility of a consistent and spatially significant data collect.

21 Referring to the presence of experimental fields learnt from the media, we have tried to verify the news with the sources or the actors directly involved. As regards the experimental fields against the anthracnose of olive trees, we have required and obtained the sequestration's decree. Meanwhile, as concerns the implantation of the GIPP Project by Monsanto, we have asked the experimental fields' location to the Apulia Region government, but it has declared "to be unable to provide any results about the experimentation" and that the regional offices do not know the requested elements.

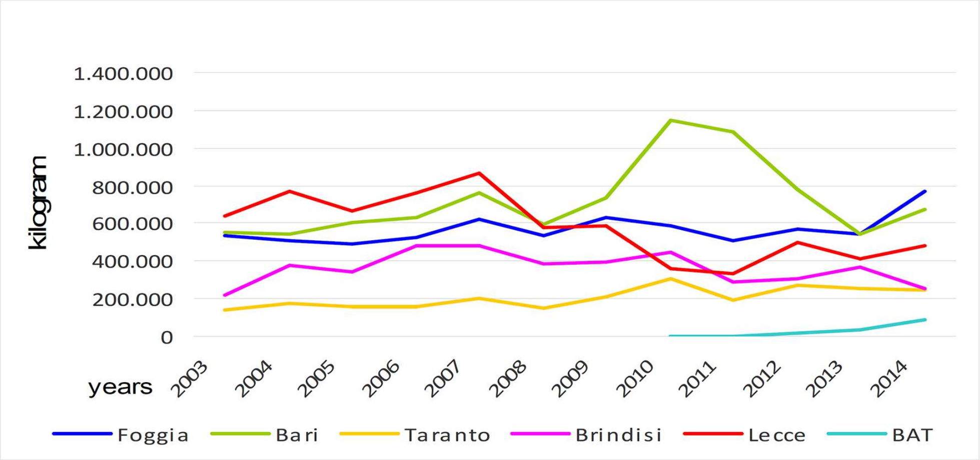
Results

The diffusion of the herbicides

22 In general, the provinces of Foggia and Bari, with the largest agricultural land surface on the regional level, are the first in the distribution of chemical products. But, if we read the disaggregate data according to the product categories (fungicides, insecticides and herbicides), we observe an "exception" about the distribution of the herbicides in the

2003-2008 period. In fact, in this last case, in the first position we find the province of Lecce (figure 4).

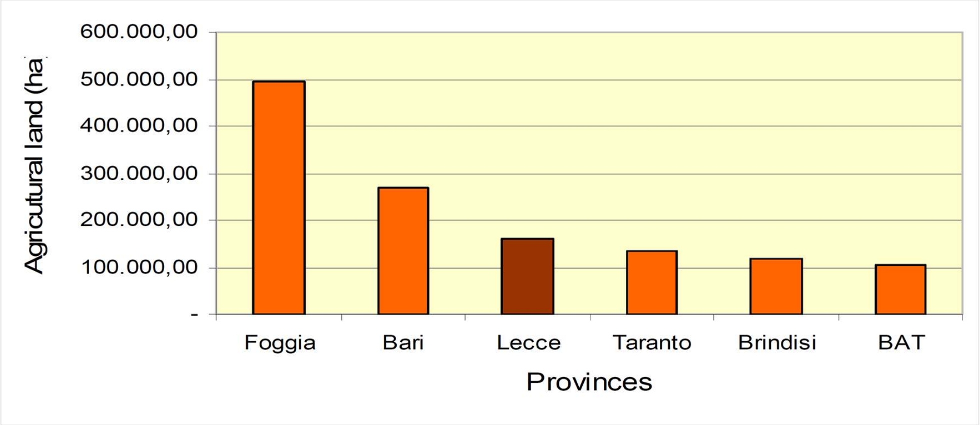
Figure 4. Apulia: the distribution of herbicides (kilograms) by province.



Source: own graphic on data by www.istat.it

23 These data present an apparent anomaly from a quantitative and qualitative viewpoint, considering the agricultural land surface and the predominant agricultural model. Indeed, the agricultural land surface (figure 5) of the Lecce province (161,130.94 hectares) represents almost a third of the province of Foggia (495,111.10 ha), and a few over the half of the province of Bari (268,312.23 ha).

Figure 5. Apulia: the agricultural land surface by province (hectares), 2010.

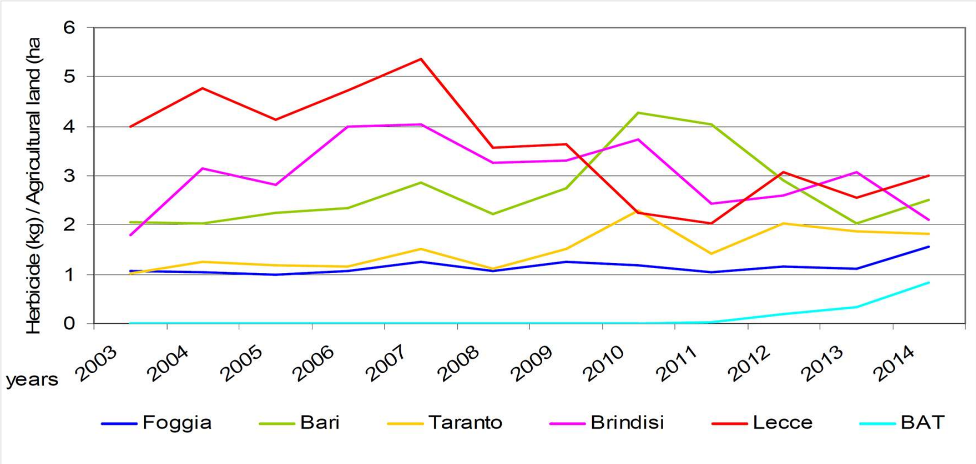


Source: own graphic on data by www.istat.it

24 Moreover, if we consider the relationship between herbicides distribution and agriculture land surface, we observe an intensification of this apparent anomaly for amount and time (figure 6). Indeed, in the Lecce province, where the first olive trees decline phenomenon has been observed, the distribution of herbicides over the agricultural land surface is until twice more than in the Bari province, and until four times more than in the Foggia province. This apparent anomaly is visible from 2003 to almost 2010. We observe a similar apparent anomaly in the Brindisi province that is the second for distribution of herbicides over the agricultural land surface, from 2003 to 2010. The Brindisi province

has been affected by the OQDS in a second time (since January 2015) with the recognition of some focus in the Oria municipality's fields (MPPAF, 2015, p. 31).

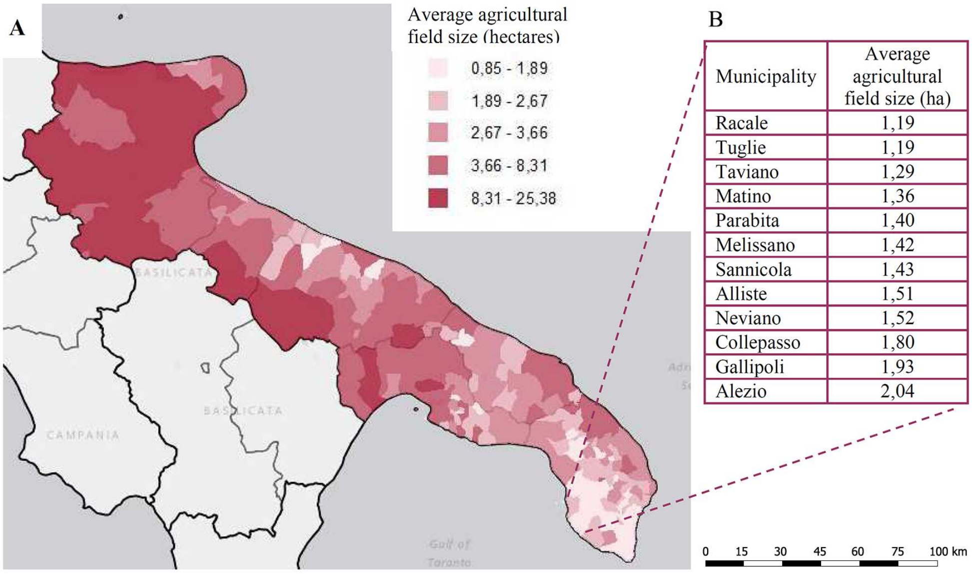
Figure 6. Apulia: the relationship between the distribution of herbicides (kilograms) and the agricultural land surface (hectares) by province.



Source: own graphic on data by www.istat.it

25 This apparent anomaly can also be considered from a qualitative viewpoint because the Lecce province is characterized by a small average agricultural field size (from 0.85 to 4.47 hectares). It does not overpass 2.04 hectares with reference to the municipalities affected by the first olive trees decline symptoms, as well as by the initial and bigger OQDS focus (figure 7). This means that the predominant agricultural model should be for subsistence and local commerce. In theory, it should use less chemical inputs than both the monoculture system (typical of Foggia province) and the intensive agriculture model (widespread in the Bari province). Besides, this is confirmed by the distribution of fungicides and insecticides, as well as of herbicides after 2009 at the provincial level. In other words, the unexpected distribution concerns only a limited period (2003-2009) and just one category (herbicides), while in the following time (after 2009) and referring to different chemical products (fungicides and insecticides) the trend confirms the theoretical expectations.

Figure 7. Apulia: a) the map of average agricultural field size (hectares), 2011; b) the average agricultural field size regarding the municipalities affected by the first olive trees decline symptoms, as well as the initial and bigger OQDS focus (hectares), 2013.



B

Municipality	Average agricultural field size (ha)
Racale	1,19
Tuglie	1,19
Taviano	1,29
Matino	1,36
Parabita	1,40
Melissano	1,42
Sannicola	1,43
Alliste	1,51
Neviano	1,52
Collepasso	1,80
Gallipoli	1,93
Alezio	2,04

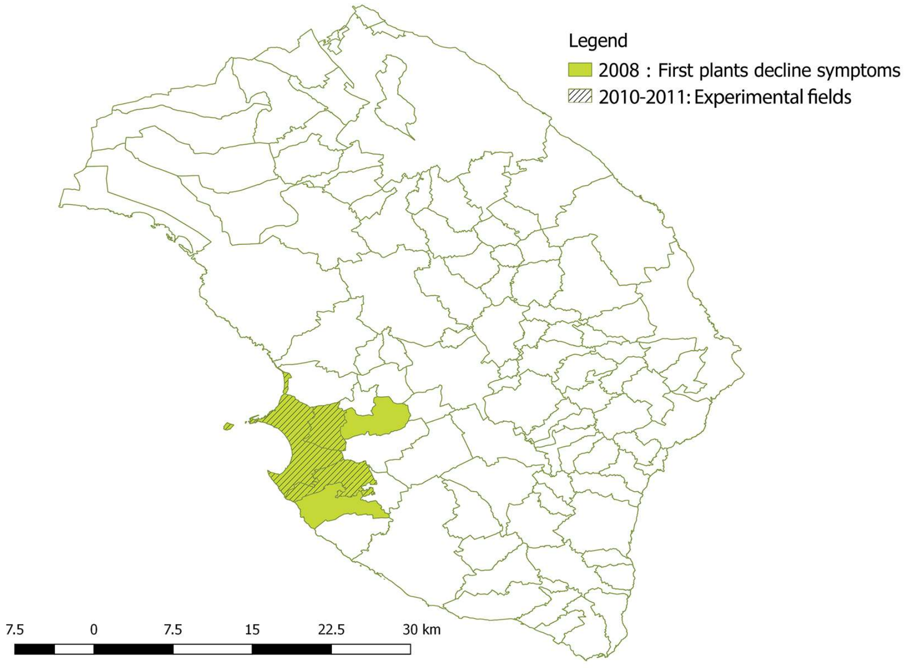
Sources: a) www.istat.it; b) own table on data by www.istat.it

The experimental fields with chemical products

26 The Lecce province has also been the subject of two chemical experimentations. The first regards experimental fields organized, in the 2010-2012 period, by the Apulia Region with the University of Bari, the Consortium for the protection of intensive production and the "Ugento e Li Foggi" Land Reclamation Authority. The aim was to verify the efficacy of new chemical products against the anthracnose of olive trees and consent the ministerial registration (Apulia Region, 2011ab).

27 These fields result localised in some municipalities where the first plant decline symptoms have been observed (figure 8): Gallipoli, Taviano, Alezio (Procura della Republica di Lecce, 2015).

Figure 8. Lecce province: the municipalities with new chemical products experimental fields promoted by the Apulia Region, 2010-2011.



Source: own map on data by Procura della Repubblica di Lecce (2015)

28 The second chemical experimentation relates to the implementation of the GIPP Project by Monsanto, from 2011 until the 2013 Spring. It is a project to control the weeds in olive orchards by the Roundup Platinum herbicide containing glyphosate (which is a systemic and not a selective herbicide) and spraying machine with specific boards for treatments, 9 metres spraying length and 4 bar pressure. Currently, we know that tests have been made for two years in the experimental farms in Lecce, Brindisi and Bari provinces (Monsanto, 2013), but the fields' location is unknown.

The organic agriculture land

29 The zones with a higher presence of organic fields are located in the north-eastern part of the Salento peninsula. Here, in the area included in the north-eastern municipalities (Lecce and Squinzano) and south-eastern ones (Melendugno, Carpignano Salentino, Castrignano dei Greci and Cursi), the average percentage of the relationship between organic agricultural land and agricultural land is almost 17% (table 1) and it can reach approximately 40% (figure 9a). This is also the area that, on the whole, appears less affected by the OQDS and also specifically by *xf* (figure 9b).

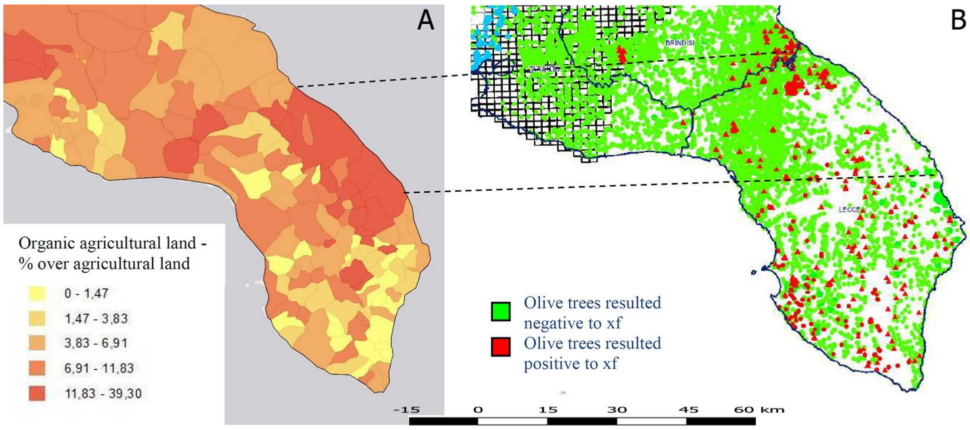
30 On the other hand, in the western Salento area where the big focus was found, the average percentage of the relationship between organic agricultural land and agricultural land is 5.55% (with a minimum value round 0 and a maximum percentage of 11.83%), that is to say less than a third of the north-eastern Salento average percentage (table 1).

Table 1. The relationship between organic agricultural land and agricultural land, referring to municipalities in the North-East Salento peninsula and in the OQDS big focus area, 2011.

Municipalities in the north-eastern Salento Peninsula	**Relationship between** organic agricultural land and agricultural land %	**Municipalities** in the OQDS big focus area	**Relationship between** organic agricultural land and agricultural land %
Lecce	15.37	Alezio	3.04
Calimera	20.58	Alliste	3.09
Caprarica	**38.77**	Collepasso	7.12
Carpignano S.	23.14	Gallipoli	10.91
Castri di Lecce	22.05	Matino	3.15
Castrignano	20.07	Melissano	7.58
Cavallino	20.17	Neviano	4.37
Cursi	15.58	Parabita	7.88
Lizzanello	11.56	Racale	**0.06**
Martano	18.46	Sannicola	1.36
Melendugno	17.12	Taviano	**11.83**
Martignano	**6.00**	Tuglie	6.23
Squinzano	17.83		
Sternatia	14.35		
Surbo	7.04		
Trepuzzi	13.69		
Vernole	12.61		
Zollino	10.25		
Average percentage	16.92	***Average percentage***	5.55

Source: own table on data by ISTAT (http://gisportal.istat.it/bt.carto/bt.carto.html)

Figure 9. South Apulia: a) the organic agricultural land, 2011; b) the *xf* diffusion, 2014.



Sources: a) www.istat.it; b) http://webapps.sit.puglia.it/freewebapps/MonitoraggioXFSintesi/

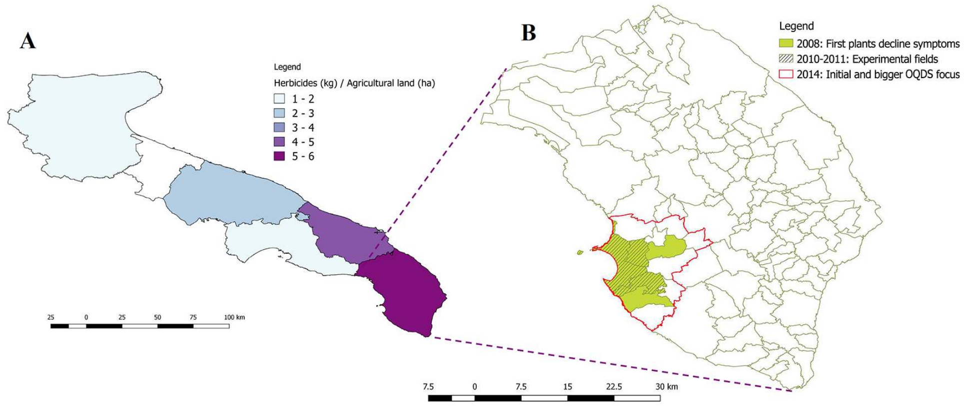
31 This is consistent with the international literature that shows that soil biochemical and ecological characteristics of the organic agriculture appear better than those of the conventional one (Gomiero, Pimentel & Paoletti 2011), and a higher biodiversity generally reduces invasibility and, thus, a spread of pests and diseases (Letourneau, van Bruggen, 2006). According to FAO "A healthy plant is less vulnerable to pest and disease infestation [...] The interaction between living organisms and their environment is crucial for a plant's health. Plant's health is more at risk in monocultures and on-farm diversification provides a balanced interaction between different plants and pests and predators. This is why a well-managed ecosystem can be a successful way of reducing the level of pest or disease population" (http://teca.fao.org/read/8372).

Discussion

32 On the regional scale, the above-mentioned data show a correlation between the OQDS and a higher distribution of chemical products. In fact, in the Lecce and Brindisi provinces affected by the OQDS, we have observed an unexpected distribution of herbicides (2003-2010) that in 2007 (the previous year to the first plant decline symptoms) amounted to the top both in absolute and relative value: 864,025 kg and 483,020 kg, respectively; 5.36 kg/ha and 4.04 kg/ha, respectively (figure 10a). In addition, in the Lecce province, in the 2010-2011 period, experiments with new chemical products have taken place in some municipalities where the first plant decline symptoms had been noticed (Gallipoli, Taviano, Alezio). These are also the zones where the initial and bigger OQDS focuses had been observed (figure 10b).

33 Data on distribution of chemical products on the local scale could be very important in order to know in greater detail the above-mentioned correlation and make clearer the initial and bigger OQDS focus origin, as well as to better understand the territorial impact.

Figure 10. a) Apulia: the relationship between the distribution of herbicides (kilograms) and the agricultural land surface (hectares) by province, 2007; b) Lecce province: the municipalities with the first plants decline symptoms (2008), the new chemical products experimental fields promoted by Apulia Region (2010-2011), the initial and bigger OQDS focus (2014).

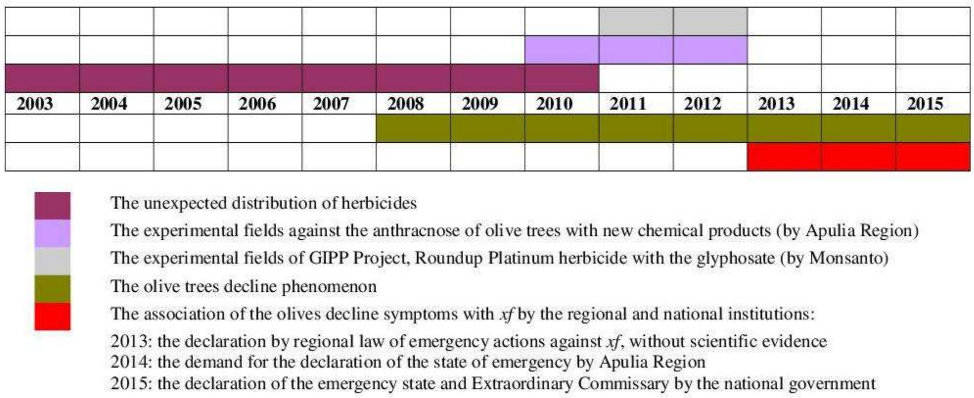


*** DATA OF BAT PROVINCE IN 2007 ARE NOT AVAILABLE BECAUSE ISTAT HAD NOT YET ADOPTED THE NEW ADMINISTRATIVE PARTITION ESTABLISHED BY REGIONAL LAW (N. 148/2004). BEFORE 2004, THE MUNICIPALITIES OF THE CURRENT BAT PROVINCE WERE PART OF THE BARI AND FOGGIA PROVINCES.**

Sources: a) own map on data by www.istat.it; b) own map on data by Procura della Repubblica di Lecce (2015) and Apulia Region (2014)

34 The time evidence between the overdose of chemical products (especially herbicides) in the Lecce province and the olive trees decline (figure 11) leads to the hypothesis that the pathogens (fungi and bacteria) have damaged the weaker plants, that is to say those in polluted and poor soils.

Figure 11. Lecce province: the time correlation between the distribution of chemical products and the olive trees decline phenomenon.



SOURCE: OWN FIGURE

35 This hypothesis needs to be confirmed by a specific and interdisciplinary research project in order to examine in depth and on the local scale the distribution and the use of herbicides (and more generally of chemical products) in the province of Lecce, and to control the health conditions of water and soil in the olive orchards affected by OQDS in the focus area. Considering this, the weak point remains the phase of information acquisition for two types of problems: the institutions' failure to provide the requested information; the presence of sensitive information or private documents (sales or

treatment books). This research project could produce important information that could be useful to understand the Apulia phenomenon and to provide additional elements for the controversy about OQDS diffusion. Furthermore, it could be of interest for a wider debate on the dangerousness and the riskiness of chemical products, the land use and the agricultural models.

36 On the provincial level, indeed, we have observed a significant difference between the West and East with reference to the OQDS and, specifically, to *xf* diffusion. The eastern zones, characterized by a higher presence of organic agricultural land, result less affected than the western areas. This confirms the remarks in the above-mentioned report, as well as the fact that it could lead to assume a positive correlation between organic agricultural land and a major pathogen plant resistance. In other words, plants under a strong stress by chemical inputs are weaker than others and thus have a higher possibility to get sick. This could also explain why in the past no large diffusion of leaf scorch and die-back of twigs and branches seems to have been recorded.

37 Furthermore, it could be very important to study of the relation between organic land and the capacity of olive plants to react to the OQDS. Therefore, we propose two mapping projects. The first refers to the organic lands in the focus area with the aim to learn the olives' reaction to OQDS. An interesting sample could be represented by the 26 organic farms localised in the Lecce Province that filed a formal complaint with success against the use of pesticides and chemical products mentioned in the governmental plan to contrast *xf* (http://aiab.it/index2016.php?option=com_content&view=article&id=3072%3Ail-tar-lazio-sospende-il-piano-silletti-per-aziende-bio-e-vivaisti-&catid=228%3Aban-9-maggio-2015&Itemid=163). For this purpose, it is essential to collect quantitative and qualitative information about the intensity of the phenomenon, the number of olive plants affected by OQDS and their relationship to the total plants, as well as the number of plants that have been cured.

38 The second mapping relates to agricultural typologies (organic, biodynamic, regenerative, symbiotic, etc.), to natural practices and activities, as well as the scientific experiments applied to cure olives, in order to check a possible correlation. A sample could be the official data referring to the projects for stopping OQDS financed by the Apulia Region (DD. n. 494/2015, 495/2015, 496/2015). To this, we could add a participative map by the farmers, inhabitants, associations, etc. having experimented natural practices against OQDS successfully. This experiment shows that agriculture typologies and land use are not neutral in relation both to the goals and to the territorial impacts, with special reference to the ecological and social dimensions. They can be a threat or a safeguard for territory, cause health or disease, equilibrium or disequilibrium. If the different forms of traditional agriculture generally sought to balance soil fertility (Parascandolo, 2016), to maintain the hydrogeological, microclimatic and ecological function of environmental systems safeguarding life (Altieri, 1995), modern agricultural systems can be dangerous for health, environmental conditions, ecological equilibrium and territorial economies. For example, the intensive/high density olive orchards (between 250 and 700 plants per ha) or super-high-density orchards (that can present densities over 1,500 plants/ha) originated in Spain in the 1990s (Freixa *et al.,* 2011; www.olivolio.net/superintensiva_en_htm), have a huge ecological and social impact due to irrigation, a wide use of chemical products, as well as (in the second case) the totally mechanized harvesting, pruning and planting that can remove the need for human labour. Also the landscape suffers considerable changes as a consequence of the super

increased densities of olive orchards and the lowered height of the trees, which transforms the traditional fields in agro-industrial fields. For these reasons we think that the proposition of developing in Apulia (as well as in other regions) a super intensive model for olive orchards (Camposeo, Godini, 2010; Godini, 2010; Bellomo, D'Antonio, 2014) is not a positive innovation for the territory.

39 A fact seems clear: a good governance of the countryside is not possible if trees are perceived and managed as objects in a box to change according to the market interest, and the territory as a banal space where one can move away the "undesired things", without taking into account the relations between physical and human elements. It requires the knowledge and a prior consideration of the ecosystem relations (especially referring to the vital matrices as water, soil, air and biodiversity) as well as a territorial dimension (public health, local economy and cultural dimension). Therefore, policy makers and economists, as well as entrepreneurs and peasants, should focus their attention on the territory rather than on the market logic, and adopt a system approach. This reflection could also offer elements of interest for the recent process of the Common Agricultural Policy (CAP) reform, considering that the CAP has a great influence on national policies and a tremendous power in the change of agricultural models.

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ABSTRACTS

The agricultural models and innovations are not neutral, in relation both to the goals and to the territorial impacts, with special reference to the ecological and social dimensions. This awareness has become the key to observe the olive quick decline syndrome (OQDS) that has affected the Apulia, a land of secular olive trees characterizing landscape and economy. By an inductive approach and according to data on the provincial level, we have verified the correlation between the ways of land use and the OQDS diffusion. In fact, in the Lecce and Brindisi provinces affected by the phenomenon we have observed an unexpected distribution of herbicides and the location of experimental fields with chemical products. The hypothesis is that the pathogens have damaged the weaker plants, that is to say those in polluted and poor soils, while the zones with a higher presence of organic agricultural land result less affected by the OQDS. Data on the local scale could be very important to know the correlation in greater detail, and make clearer the OQDS focus origin, as well as to better understand the territorial impact.

Les modèles agricoles et les innovations ne sont pas neutres quant à leurs objectifs et leurs effets territoriaux (notamment dans leurs dimensions écologique et sociale). Nous utilisons cette clé d'observation pour analyser le complexe du dessèchement rapide des oliviers (CDRO) qui a affecté les Pouilles, terre où les oliviers séculaires marquent le paysage et l'économie. Par une approche inductive et sur la base des données à l'échelle provinciale, nous avons vérifié la corrélation entre les modalités d'utilisation de la terre et la diffusion du CDRO. Dans les provinces de Lecce et Brindisi, affectées par le phénomène, nous avons observé une distribution massive d'herbicides et la présence de champs d'expérimentation de produits chimiques. L'hypothèse est que les pathogènes ont affecté les plantes les plus faibles, c'est-à-dire celles qui sont dans des terrains pauvres et pollués. Par contre, les zones moins affectées comptent une plus grande présence de terrains conduits selon les modalités de l'agriculture biologique. Les données à l'échelle locale pourraient aider à affiner l'étude des corrélations et à rendre plus claire l'origine de l'épicentre du CDRO, ainsi qu'à mieux comprendre l'impact territorial.

INDEX

Mots-clés: modèle agricole, complexe du dessèchement rapide de l'olivier, Xylella fastidiosa, herbicide, les Pouilles, Italie
Keywords: agricultural model, olive quick decline syndrome, Xylella fastidiosa, herbicide, Apulia, Italy

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