

«Hands off the olive trees!»: the epistemic war in the Xylella fastidiosa epidemic in Italy. A Computer-Assisted Text Analysis of User-generated content on social media

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Open Essays and Researches

## «Hands off the olive trees!»: the epistemic war in the *Xylella fastidiosa* epidemic in Italy. A Computer-Assisted Text Analysis of User-generated content on social media

GIUSEPPE TIPALDO<sup>1</sup>, FABIO BRUNO<sup>2</sup>, SARA ROCUTTO<sup>1</sup>

<sup>1</sup> *Università degli Studi di Torino*

<sup>2</sup> *Quaerys srl*

giuseppe.tiplado@unito.it (corresponding author); fabio.bruno@quaerys.com; sara.rocutto@unito.it

**Abstract.** The article focuses on the online storytelling concerning the *Xylella fastidiosa* outbreak in the Apulia region (Italy), as represented by a collection of User-generated content retrieved from Facebook, YouTube, and Reddit over a time span of 6 years (>16k comments). We examine the episode as a revelatory case of framing mechanisms that, in many technoscientific conflicts, enable different epistemologies to compete on an equal basis: «mainstream» scientific knowledge, and «alternative» contents (i.e. «non-orthodox» science, local and traditional knowledge). We use Computer-Assisted Text Analysis (CATA) to investigate popular themes and their semantic vocabulary. We find that discourses on *Xylella fastidiosa* are strongly polarized and structured around two conflicts: «expertise vs. politics» on one hand, and «scientific vs alternative» solutions on the other. Then, we identify three main knowledge production strategies and introduce a typology of «non-mainstream» methods and cures, highlighting the formal traits and argumentation strategies that may have made them more credible than knowledge provided by «official» science. We nevertheless call for more research that may find a recursiveness in such framing mechanisms in the online representation of other technoscientific conflicts.

**Keywords:** *Xylella fastidiosa*, technoscientific conflicts, epistemic wars, framing, experience-based expertise, science-related populism, social media, computer-assisted text analysis.

### 1. THE CASE UNDER SCRUTINY

During the summer of 2013, a series of farmers from Salento, Apulia's southern sub-region (Italy), noticed an alarming phenomenon: a group of olive trees showed signs of desiccation, and pruning did not seem to have

any positive effect. The symptoms appeared to be so aggressive that the first trees were already dying, while the surrounding plants were beginning to get sick.

The olive growers turned to Dr. Donato Boscia, head of the Bari branch of the Italian National Institute for the sustainable protection of plants (IPSP-CNR), who asked his mentor, Prof. Giovanni Martelli, for advice. Martelli, Professor Emeritus at the University of Bari, was among the leading experts on *Xylella fastidiosa* (hereinafter referred to as *X. fastidiosa* or simply *X.*), a bacterium – hitherto unobserved in Europe – which has infested many American crops for over a century and a half, including Brazilian citrus groves, Costa Rican oleanders and Californian vines. Here, *X.* has caused Pierce's disease, which manifests itself with a pathogenesis quite similar to that observed in the Salento area (Bassi *et alii* 2016; Almeida *et alii* 2008; Efsa 2016; 2015).

In October 2013, analyses conducted by Boscia's team demonstrated that the disease – named «Olive Quick Decline Syndrome» (OQDS) – was indisputably associated with the presence of *X.* DNA on all the diseased plants. Within a month, the Regional Council of Apulia issued an emergency plan (Regione-Puglia Dgr 2023/2013), approved by the European Food Safety Authority (Efsa 2013): since there was (and still is) no cure, the only possible options to prevent an outbreak were pruning, eradication of trees with symptoms, and use of chemical treatments against vector insects (Saponari *et alii* 2014).

General Giuseppe Silletti of the Forest Police was appointed Commissioner of the Italian government for the emergency in the Apulia region, with the assignment to contain the epidemic. His measures required eradicating every plant showing symptoms of OQDS and all the asymptomatic plants in a radius of one hundred metres. Along with the first eradications of infected plants, however, tensions arose; the olive trees are admittedly part of the cultural heritage that has forged the social identity of local communities.

Between 2014 and 2015, Maria Luisa Mastrogiovanni – a local journalist – came into the limelight because of the doubts she raised about the spontaneous appearance of OQDS. She first mentioned an illegal intervention by the Monsanto corporation and then attributed some responsibilities to the group of IPSP-CNR researchers who had isolated the bacterium: in her account, in 2010 *X.* would have escaped from their laboratory during a test. Both theories were endorsed and amplified on social media by well-known Italian opinion leaders (i.e. comedians and bloggers Beppe Grillo and Sabina Guzzanti), as well as some prominent politicians belonging to the 5 Star Movement (M5S), a populist, anti-establishment national party (Pirro 2018; Tipaldo, Pisciotta 2014).

Therefore, on 18 December 2015, the public prosecutor's office in Lecce (the province capital) ordered the emergency seizure of all olive trees destined for eradication. General Silletti and five scientists (including team leader Boscia) were charged with the culpable outbreak of plant disease. The action, in fact, neutralised the «Silletti plan», and the General himself would resign less than a week later. Meanwhile, the new Apulia governor, Mr. Michele Emiliano, welcomed the justice intervention, declaring that the region was ready to support any alternative solution to cure the epidemic which did not involve the felling of the olive trees.

For the following four years, various solutions were tested, but none proved effective in containing the epidemic (Elbeaino *et alii* 2014; Haelterman *et alii* 2015; Bassi *et alii* 2016; Coletta-Filho *et alii* 2016; Logrieco *et alii* 2016; Boscia *et alii* 2017; Saponari *et alii* 2017; Luvisi *et alii* 2017; Bucci 2018; Scortichini *et alii* 2019). When, in May 2019, the accusations of the judiciary were dismissed, millions of olive trees had already been lost. As of 2022, the disease has become endemic, attacking centuries-old olive trees in the province of Bari, more than 250 km north of the area where the first outbreak took place in 2013.

## 2. THEORETICAL FRAMEWORK AND RESEARCH QUESTIONS

### 2.1 A cultural sociological approach to technoscientific conflicts

A series of recent events with unexpected results (above all Brexit and Trump's victorious campaigns) have contributed to rekindling public interest in how the spreading of «alternative truths» to the «mainstream» scientific vulgate may affect contemporary democracies (McIntyre 2018; Collins *et alii* 2017).

While not dismissing *tout court* the potential value of prescriptive positions, our contribution intends to circumvent the slippery terrain of normativity, which permeates the academic debate especially since the *Oxford English Dictionary* announced «post-truth» as the 2016 word of the year – see, for an overview, Mede, Schäfer (2020); Pellizzoni (2019). Following Harambam and Aupers (2015), we prefer to embrace a cultural sociological approach. According to this perspective, the technoscientific conflict arising from the *X.* epidemic denotes a form of «boundary work» (Gieryn 1983) related to «science wars» (Gieryn 1999). In other words, tensions and fights are generated by the competition between different forms of knowledge<sup>1</sup> (Star and Griesemer 1989), struggling for the monopoly of epistemic authority to define the truth (Gieryn 1999; Harambam, Aupers 2015). We use this expression to encompass both conflicts within the scientific community and those between scientific and «alternative» knowledge, which arise when defending epistemic borders or grabbing new territories.

Before moving forward, it is important to remark that disputes involving science, politics, and society have been under scrutiny of social sciences since the first attempts to describe and pattern their reciprocal influences during the late 1970s (see, to quote a few: Brante 1993; Collins 1975; Markle and Petersen 1981; Nelkin 1979; Mazur 1981). For some scholars, technoscientific controversies represent a symptom of the vitality of the public sphere: Nichols (2017) argues, for example, that tensions between experts, politics, and the lay public are an endemic trait of democratic regimes since ancient times because, as Jasanoff and Simmet (2017) and Fuller (2018) have pointed out, power and knowledge have always been (even more so today) inextricably intertwined.

However, we believe *X.* may offer empirical evidence that things are more complicated than that in terms of at least two relevant dynamics: the process of delegitimization of the epistemic authority of science; the mediatic construction of arguments in favour of «alternative epistemic authorities» and/or against «mainstream» science (Mede, Schäfer 2020: 479).

## 2.2 Contesting scientific authority: context, «motives», and roles.

As mentioned above, the questioning of the epistemic authority of science is not a new fact. Yet, quite a few scholars consider the most recent conflicts between science, politics, media, and society to be significantly different from those of the past (for a review, see Mede and Schäfer 2020). Despite the apparent heterogeneity of views, it seems to us that at least three characteristics are common to many contributions in literature. Describing them briefly is useful to focus on the research questions of our fieldwork.

The first is an element of context and pertains to the Sociology of Knowledge from its very beginnings (see Berger, Luckmann 1966; Mills 1940): we refer to the need of every human being to situate his or her own and others' actions in a context of meanings subjectively perceived as plausible in response to *questions*, within the meaning given by Mills (ivi 905): «unexpected programs or [...] “crises”». In this regard, in a context «pervaded by epistemological suspicion» (Van Zoonen 2012: 56), we consider it highly plausible that the sudden and rapid desiccation of olive trees in Apulia produced in the local population that sense of displacement and frustration of normality that Mills indicates as the antecedent of a motive. Hence the first two questions of our research:

*RQ.1 Which themes prevail in online users' conversations about X.?*<sup>2</sup> Addressing this question will offer some insights into the most prominent ideas used to debate and make sense of the epidemic event.

*RQ.2 How are themes mutually related?* This will give an insight into the latent factors that semantically structure how users define the epidemic event and respond to it.

<sup>1</sup> According to Mede and Schäfer (2020), and Harambam and Aupers (2015), in the course of the exposition we will refer to «official» science also as «canonical», «institutional», «mainstream», «orthodox». Oppositely, we will refer to «alternative» knowledge also as (depending on the context and specificity required): «folkloristic», «non-mainstream», «non-orthodox», «traditional», «unofficial».

<sup>2</sup> The social media platforms selected for data retrieval are Facebook, YouTube, and Reddit Italia; for details, see par. 3 and tab. 1.

The second of the three points anticipated above concerns the dynamics of the social construction of narratives that discredit the so-called «politics of evidence-based policy making» (Cairney 2016), which is the privileged «role long given to science in public affairs» (Pellizzoni 2019: 116) to «speak truth to power» (Wildavsky 1979). In the literature consulted, the loss of this privilege is ascribed to a wide range of concauses, including: society's increasing propensity to inquire into science (McIntyre 2018; Collins *et alii* 2017); the consequent «decentralization» of knowledge in society (Gosa 2011; Martelo-Landroguez *et alii* 2019); the disintermediation of communication on technoscientific issues brought about by social media (Waisbord 2018; Tipaldo 2019); the rise of political populism (Van Zoonen 2012; Crabu, Magaudo 2020; Mede, Schäfer 2020; Tipaldo 2019); and, finally, the rising salience of values attributable to «civic narcissism» (Papacharissi 2008; Thorne 2010; Twenge 2013).

This last aspect, in particular, identifies an individual's propensity to elect the «Self» as the centre of gravity of the system of criteria with which content is validated or falsified. The rise of the «self-as-the-source-of-truth» (Van Zoonen 2012: 57) is accompanied by two concomitant phenomena: on one hand, a growing «emotivism» (MacIntyre 2007: [1981]), «which makes truth and morality a matter of individual taste and feeling» (Van Zoonen 2012: 57); on the other, the proliferation of conspiracy theories, i.e. alternative explanations to those provided by «official» science, constructed to give «an illusion of knowledge and control, of causal connections in a chaotic world and of clearly identifiable actors (Muslims, “the Left”, Jews) or institutions (Big Pharma, «the Government») to blame» (Van Zoonen 2012: 60).

From what has just been summarised, further research questions emerge, the answers to which will highlight the most pregnant strategies in the «boundary work» made by diverse knowledge providers competing to define the truth about X:

*RQ.3 Are there any traces in the public discussion generated by online users of «alternative» versions to the «institutional» scientific narrative about X?*

*RQ.4 Are conspiracy theories about the X. epidemic present and what narrative structure do they reproduce?*

The third and final point of our theoretical discussion concerns the social construction of the stakeholders involved in epistemic conflicts and what they verbalize to be their «call to action». In this regard, a longitudinal analysis of some of the most striking Italian cases has shown that competing epistemic authorities are mutually represented through the categories of the «hero» and the «anti-hero» (Tipaldo 2019). Mede and Schäfer's review (2020) of the international literature also converges on the same position, from which it emerges that both «official» science and «alternative» knowledge construct and reinforce their own identities by using normative, stereotyped representations of the other, impermeable to the contamination of ideas. Polarization is even stronger when controversies involve conspiracy theories (Bessi *et alii* 2015; Oliver, Wood 2014). On one hand, in fact, academics attribute «selected characteristics to the institution of science [...] for the purposes of constructing a social boundary that distinguishes some intellectual activity as non-science» (Gieryn 1983: 782) and, at the same time, they «critique the empirical, epistemological, and methodological flaws of conspiracy theories and, based on that, label them as “bad science” [...] [to] reinforce such a “modern divide” between “rational” science and its alleged “irrational” counterparts» (Harambam and Aupers 2015: 468-469).

Oppositely, the counterpart of scientific knowledge considers itself a «homogeneous collective of allegedly virtuous, lay, “ordinary” people» (Mede and Schäfer 2020: 480), regarding the truth claims made by «mainstream» science as «tied to particular social and material interests, and therefore not to be believed, or at least taken with scepticism» (Van Zoonen 2012: 56). Within these circles, the scientific elite is depicted as the wicked antagonist of the pure and honest lay public (Mudde, Rovira Kaltwasser 2018), «a cohesive, monolithic entity detached from the people but ultimately deciding over their future» (Mede, Schäfer 2020: 476). In some cases, the sense of suspicion emerges as «denials of the disinterestedness and objectivity of organized science and attempts to replace established knowledge with seemingly better (but still scientific) “counterknowledge”» (ivi: 478). In others, scientific authority is utterly rejected and replaced by a vast array of «motives» drawn from common sense, tradition, folklore, emotions, and/or conspiracy theories.



To address this last point in our article, we formulated the following research question:

*RQ.5 What «motives» can be found in our empirical documentation to produce and/or promote «alternative» epistemic authorities about the X. case, particularly speaking on solutions to contain the epidemic?*

### 3. METHODS

This contribution is based on an exploratory Computer-Assisted Text Analysis (CATA) of User-generated content (UGC) posted on the Italian version of Facebook, YouTube, and Reddit in the November 2013–October 2019 period. We have selected the above-mentioned social media platforms for the following reasons:

- to have direct access to users' comments on news about *X.* provided by official pages of newspapers, magazines, and opinion leaders. In relation to this, we considered as primary sources the pages of newspapers from the Salento area and Southern Italy («Lecce Prima», «La Gazzetta del Mezzogiorno», «Corriere Salentino», «Nuovo Quotidiano di Puglia Online»), to which we chose to integrate two national newspapers of different views («La Repubblica», with a progressive vocation, and «Il Foglio», closer to the moderate and conservative area). In addition, we selected three magazines with a popular vocation on issues related to technoscience, albeit in quite different styles («Le Scienze», «Nuova Terra», and «Valigia Blu»). Finally, we took into consideration the public profiles of some opinion leaders (Sabina Guzzanti, the band Sud Sound System and its leader Nandu Popu) and that of a popular television programme («Le Iene»). These are sources that, according to the reconstruction provided at the beginning (see par. 1), played an active part in the case;
- to maximise the probability of intercepting messages of a longer average length than those normally produced on micro-messaging platforms, such as Twitter;
- to retrieve content back in time without constraints in terms of the date of access;
- to avoid possible paywalls, present in many digital media outlet archives, including Twitter's Firehose.

The general corpus (N comments = 16,143, see tab. 1) was assembled via a mix of automatic (Reddit and YouTube) and manual (due to Facebook limitations to its Graph API at the time of analysis) data-retrieving protocols. On this textual basis, we performed a variety of pre-treatments and analyses employing two software packages, R Studio and T-Lab. The processes of data collection and analysis are further discussed in the «Methodological note» (see *Appendix 1*).

The acronym CATA refers to «a family of methods wedding statistical analysis of texts with interpretative techniques» (Anstead 2018: 292), which are deemed to be ideal tools in the analysis of media frames in technoscientific conflicts (Neresini, Lorenzet 2016), and have been mobilised for research in STS for about a decade now (see, for example, Venturini 2012; Ribes, Vertesi 2019; Neresini 2017).

The quantitative part of CATA consists of the Thematic Analysis of Elementary Contexts (TAEC) included in T-Lab. The software follows an algorithmic logic based on a double reiteration of the process detailed in the «Methodological note» (see *Appendix 1*). The technique, in short, provides a bi-dimensional map of homogeneous semantic clusters (i.e. isotopies) into which one or more *corpora* are divisible. Each cluster consists of a set of sentences or paragraphs (i.e. «Elementary Contexts», or EC), characterized by the same lexicon patterns; each cluster can thus legitimately be interpreted as a representation of the themes which inform the textual material under scrutiny (Rastier *et alii* 2002). In accordance with the exploratory nature of our investigations, we selected the «bisecting K-means» partition method of unsupervised learning (Karypis *et alii* 2000)<sup>3</sup>.

It should be noted that TAEC is not completely automated nor based on a black-box process. T-Lab allows a closer examination of thematic clusters, as text excerpts are ranked by the peculiarity of their lexicon and are fully searchable. The software applies a chi-square test to control the significance of each cluster vocabulary, and high-

<sup>3</sup> The levels of association achieved with our two-dimensional model are consistent with those found in other researches applying the same methodology, although in the field of political communication – see, for example, Anstead (2018); Schonhardt-Bailey (2005).

**Table 1.** The sources used to build our *corpus*.

Network	Public pages/channels	N Vocabulary
Facebook	«Lecce Prima» (lnp)	
	«La Gazzetta del Mezzogiorno» (nnp)	
	«Corriere Salentino» (lnp)	
	«Nuovo Quotidiano di Puglia» (lnp)	
	«la Repubblica» (nnp)	
	«Il Foglio» (nnp)	14,562 (comments)
	«Le Scienze» (m)	
	«Nuova Terra» (m)	305,208
	«Valigia Blu» (m)	(occurrences)
YouTube	Sabina Guzzanti (comedian)	
	Sud Sound System (pop band)	
	Nandu Popu (singer)	
	Le Iene (tv programme)	
	50 most relevant videos about Xylella filtered by the embedded search engine	882 (comments)
		31,407 (occurrences)
Reddit	Posts from the channel «Italy», filtered by keyword «Xylella»	699 (comments)
		14,700 (occurrences)
Vocabulary (total)		16.143 (comments)
Facebook, YouTube, Reddit		351.315 (occurrences)

lnp: local newspaper; nnp: national newspaper; m: magazine.

lights those words with a disproportionate occurrence in each subset, minimizing «cherry-picking» biases due to the content analyst's subjectivity (for a discussion see, among others: Krippendorff 2004; Baron *et alii* 2009; Baker 2006). This is also important because it facilitates presenting and discussing the results by way of a methodological triangulation between quantitative data and in-depth qualitative systematization of textual portions (on textualization, see: Cardano 2020; for an application very similar to ours, see: Anstead 2018).

Moreover, to provide readers with a more accurate description of the solutions to the QQDS epidemic supported by «alternative» epistemic authorities, we deemed it helpful to introduce pieces of information from external sources (mainly online news with related user-generated comments), which are merely used to make the outputs discussion clearer. This derogation to the method is limited to the typology in par. 4.3.

This study has some limitations, which we would like to briefly consider before presenting the results. The most evident one is that our research design does not allow out-of-sample generalizations. The digital data we collected are indeed typically nonrepresentative (Salganik 2019) and subjected to not fully accountable procedures in the phase of semi-automatic retrieving, due to the API (*Application Programming Interface*) policies of each service. On the other hand, we tried to counterbalance this limitation by retrieving all available data on our subject. Secondly, the analysis only accounts for conversations in Italian, even though the *X.* outbreak echoed outside Italy's boundaries, thus further limiting the scope of the conclusions. Lastly, the three social media platforms we selected are arguably diverse in many aspects (i.e. policies, diffusion, active users, etc.), yet they all share suitable traits for a

study based on the analysis of online conversations: they organize discussions in thematic threads; they don't limit interactions to very short messages; they encourage writing along with/instead of visual communication.

If the limits above would largely represent an issue in a statistical design based on the «generalization from a sample to the population from which it is drawn» (Salganik, 2019: 31), they are not necessarily an obstacle in an exploratory design such as ours. Our aim is indeed to find meaningful patterns in one specific group that future works on the online representation of technoscientific disputes might find «transportable»<sup>4</sup>.

## 4. RESULTS

### 4.1 Identifying the themes

The TAEC performed to answer Q1 returns 5 thematic clusters associated with our case study (fig. 1), which we present accompanied by an extract of the corresponding peculiar lexicons (sorted by descending  $\chi^2$  values, see tab. 2).

More specifically, cluster 1 (ECs 3,335; 24.9% of total ECs) hosts the conversations in which the decoding of the adverse event is particularly eloquent, far from the reconstruction accepted by the scientific community. The first nucleus, which we called «alternative solutions», focuses on the disease, and is saturated with two themes. Firstly, the doubt on the etiological link between *X.* and OQDS: «disease», «problem» and «existence» are among the cluster's peculiar lemmas (tab. 2). Secondly, the production of an extensive wealth of alternatives to the eradication imposed by the «Silletti plan» (see par. 1): «understand» and «cure», and all lemmatical derivations

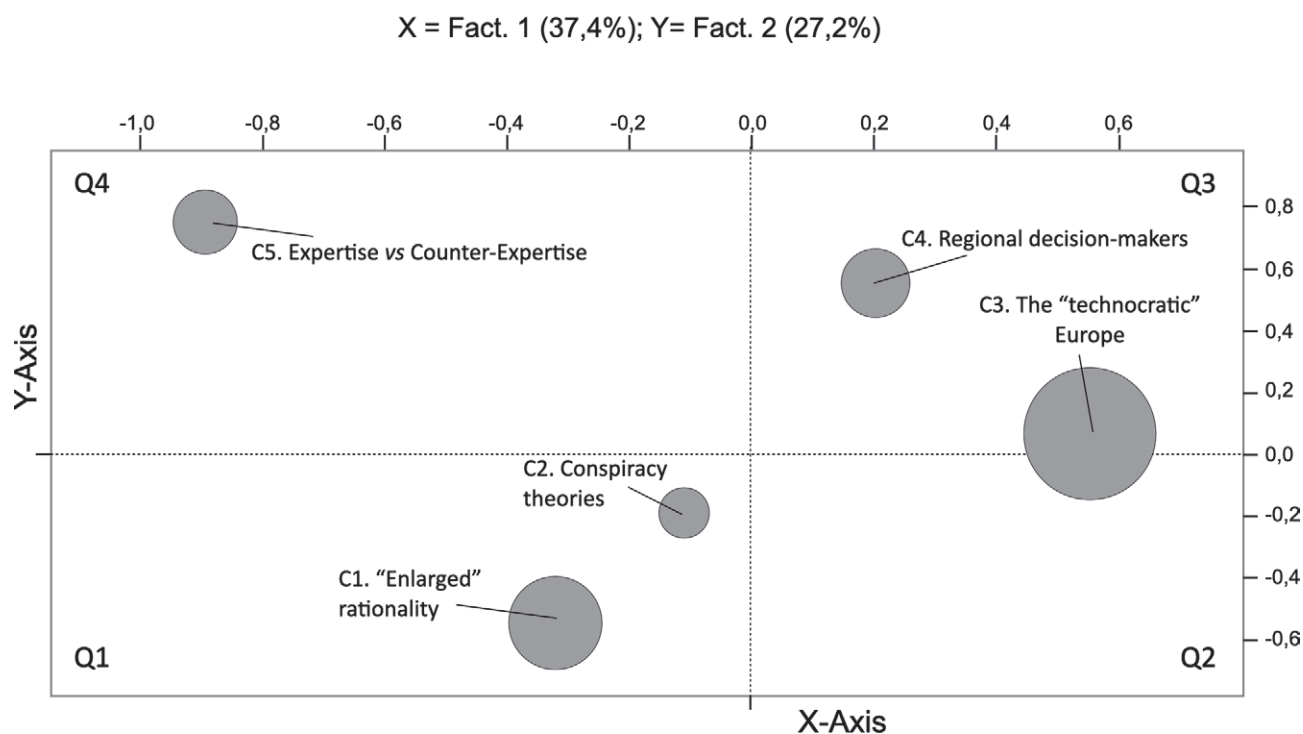


Figure 1. TAEC of UGC on *Xylella*.

<sup>4</sup> The idea of «pattern transportability» in social research based on digital data is discussed in Salganik (2019).



**Table 2** Peculiar lexicon within each cluster (words are ranked by their  $\chi^2$  score and all have a p-value  $\leq 0.001$ ).

Cluster 1 <i>Enlarged» rationality</i>		Cluster 2 <i>Conspiracy theories</i>		Cluster 3 <i>The «technocratic» Europe</i>	
<i>Word</i>	$\chi^2$	<i>Word</i>	$\chi^2$	<i>Word</i>	$\chi^2$
Xylella	1127.13	Monsanto	1188.54	our	1497.74
bacterium	437.58	think (to)	885.23	olive trees	1275.77
tree(s)	366.94	pipeline	647.48	oil (olive)	741.93
plant(s)	324.03	pass (to)	617.51	Salento	619.33
understand (to)	219.67	GMO(s)	353.23	European Union	558.92
problem	208.04	chemtrails	242.25	thanks	533.50
cure(s)	207.04	TAP	197.68	land	398.89
exist (to)	197.92	time	184.04	good	389.82
disease	192.13	blame	147.76	great	375.63
talk (to)	180.53	arrive (to)	129.09	destroy (to)	361.84
Cluster 4 <i>Regional decision-makers</i>		Cluster 5 <i>Expertise vs counter-expertise</i>			
<i>Word</i>	$\chi^2$	<i>Word</i>	$\chi^2$		
see (to)	1826.05	read (to)	920.82		
Emiliano (Michele)	921.63	article(s)	855.62		
politician	777.41	write	584.75		
vote (to)	522.60	believe	503.26		
piss off (to)	264.44	Beppe Grillo	469.92		
take (to)	242.71	true	326.48		
Democrats	231.59	approve (to)	256.14		
be ashamed of (to)	219.26	science	247.56		
government	185.39	look (to)	226.79		
bastard	157.02	comment(s)	219.54		

are the terms with the highest degree of significance within the cluster's vocabulary, excluding from the list occurrences that contain a direct reference to the affair, e.g. «Xylella», «bacterium», «tree», «plant».

The numerous extracts that belong to this group include, for example:

«ERADICATIONS + PESTICIDES... and what if it wasn't XYLELLA! The idea of the bacterium as the cause for the quick desiccation of the olive trees (OQDS) remains only a pseudo-scientific hypothesis. (...) Despite these and many other doubts and questions, an intervention plan has been prepared based upon the – scientifically inconsistent – assumption that the only cause of the desiccation is the XYLELLA bacterium».

«Facebook», April 2015 (emphasis in the original)

The second cluster (ECs 2,023; 15.1%) contains the conspiracy narrative associated with the sudden appearance of the disease and the «good reasons» why it is legitimate to suggest that higher interests are benefiting from the epidemic. Among the many fragments, two of the most eloquent are the following:

«Maybe Apulia, with its oil and tourism, is starting to annoy many people in recent years. It's a sin to think ill of others but if you do it in this country you are right most of the time!».

«Facebook», April 2015

«Then again you don't get that this is a state conspiracy!!!! (...) the multinationals get rich (...) these bastards are taking everything away from us».

«Facebook», February 2016

The protagonist of the conspiracy theories is Monsanto. According to local and national opinion leaders (see par. 1), the corporation produced GMO seeds and plants resistant to the bacterium. At a later stage, the TAP (*Trans Adriatic Pipeline*) is viewed with suspicion. The project has, in fact, its receiving terminal on Italian soil in the Salento municipality of San Foca<sup>5</sup>. The related comments share the tenor of the few (for the sake of brevity) below:

«Multinational corporations like Monsanto keep us and the whole Earth under their thumb! (...) Monsanto's involvement in the technological process to induce an infinite drought is clear. (...) (the flora) will all be replaced by a GMO flora which will no longer be called GMO as it will be the new ORGANIC. (...) Monsanto is behind this. This comment may be banned».

«YouTube», March 2015

«Watch out: there will no longer be trees (which are dying everywhere), Monsanto wants to REPLACE and HOMOLOGATE all the world's vegetation it can get its criminal hands onto».

«Facebook», May 2018

«After a long silence... new life is unexpectedly given to the local speculation to make way for the Great gas pipeline project... gas produces profit... olive oil production is against the agricultural commercial policies of the EU».

«Facebook», March 2019

Quadrant three encompasses the authors' frustration, which seems to emerge firstly from the sense of impotence versus the felling of the plants and, secondly, from a strong sense of bewilderment, when one «alternative solution» after the other is found to be ineffective:

«As someone from Brindisi and from Apulia, I feel personally humiliated, attacked; the trees' destruction is, to me, a huge rape of my land. It makes me sick to see this massacre. What a disgrace, (profanity), what a disgrace!».

«YouTube», April 2015

«Tell me: in what part of the world does someone cut all the plants in the 3 hectares surrounding a diseased one? They are felling the healthy ones».

«Facebook», November 2015

«Let's kill 'em bastards... They must die... they are ruining our history and our wealth... we must wake uppppp!!!! Our grandparents have done so much to grow our olive trees... without them, we are finished».

«Facebook», July 2019

The users do not resign themselves to the gradual desertification of the olive groves, and they attribute full political responsibility to the European Union (C3) and the regional government (C4).

Most of the textual excerpts in C3 (ECs 2,152; 16.1%) are based on a nature personification narrative, placing the olive trees at the centre of a story with a strong emotional-evocative impact, in which the plants are a vital part of a territory's social identity and are to be saved at any cost. The following one is among the most popular – we hereby provide only a few sentences due to its excessive length:

«I never wanted to write these words... in fact, I am not even writing them. I am thinking them. But I like to believe that while I am slowly starting to burn, someone is writing them down... (...) Nobody (and believe me I have had many owners in over 3 centuries) has ever been allowed to hurt me. (...) And the oil is my way to say thanks to all the generations that took care of me (...) And your rage, your tears, are your way to defend me (...) Beyond any border, beyond any ideology, beyond any bacterium».

«Facebook», November 2015

<sup>5</sup> The issue of the *Xylella*-TAP relationship was expanded by the «5 Star Movement» website and by Sabina Guzzanti (an Italian TV comedian); Guzzanti, on 1 April 2017, wrote a post on Facebook eloquently titled «Ulivi: si spiega il complotto» («*Olive trees: the uncovered conspiracy*»).

Defending the Salento olive trees from uprooting does not just mean protecting the local economy but, above all, honouring the ancestral memory and identity of an entire people: everybody is proudly summoned to oppose Europe, seen as a cynical and technocratic antagonist:

«let's defend our territory and our products from these dark forces that want to see us enslaved by the European Big Brother!». «Facebook», November 2013

«It is the latest massacre attempted by Europe!». «Facebook», April 2015

«This is what Europe now wants: to destroy our economies, our heritage our identity, and our borders. Our government is an accomplice». «Facebook», February 2016

The resentment against the regional public decision-makers coagulates around C4 (ECs 4,523; 33.8%), in relation to which the discussions often verge on verbal violence and foul language:

«The worst enemies of the South are always the politicians of the South!». «Facebook», April 2015

«who knows how much money these Mafia bastard politicians are pocketing». «Facebook», February 2016

«The PD (Democratic Party, ed.) should kick Apulia President Emiliano's ass». «Reddit», May 2018

«Emiliano you are nothing but a fool and the ruin of Apulia». «Facebook», March 2019

As regards the fifth cluster (ECs 1,358; 10.1%) – to which the texts below refer – there is a clash between two polarised groups, not tolerant of each other: on one side, the supporters of the epistemic authority of «mainstream» science, who report the scientific literature on *X*. to annihilate, or at least disprove, arguments and beliefs from «alternative» epistemologies; on the other, the sympathisers of «non-orthodox» scientific knowledge and those devoted to epistemologies derived from «traditional» or «folkloristic» know-how, not rarely based on conspiracy theories. Each party is stuck on its uncompromising positions and consolidates its wealth of knowledge with arguments that often cross over into trolling or dehumanizing language:

«Read and get informed. They're not always telling the truth, you know». «Facebook», December 2018

«Asbestos was science too and, today we find ourselves with a poison that has killed thousands of people, so when you don't know, stop talking science...». «Facebook», November 2015

«How the fuck can you be so stupid and fall for all the bullshit that the web scammers are giving you?». «Facebook», September 2018

«How can this madness be controlled? Profanities and flamethrowers? I am genuinely worried». «Reddit», July 2018

«You believe in chemtrails, why don't you kill yourselves?». «Facebook», September 2018

#### 4.2 *The mutual relations among the themes and what they are eloquent for*

We have, thus far, gained some understanding of the main themes used by online users to discuss the *X.* epidemic. Next, to address Q2-4, we need to return to fig. 1 and explore how the five clusters are represented in the bi-dimensional space. In the map, the x-axis (factor 1) accounts for 37.4% of the total amount of associations and the y-axis (factor 2) for an additional 27.2%. Hence, the two-dimensional model accounts for 64.6% of the total variation in the corpus (details provided in *Appendix 1*, tab. C).

Based upon the position of clusters C3 and C5, the x-axis seems to encompass two broad lines of conflict: one (right side of the axis) lies within the political sphere, and will not be developed in this contribution; the second (left side) relates to the role of «alternative» epistemologies and will be further discussed in the next paragraph.

The y-axis, instead, is characterised by the quest for solutions. It indeed moves from themes related to crisis management policies (C4 and C5, top) to an analysis of the epidemic conflicting with the «official» account provided by scientific and public authorities (C1, bottom).

By triangulating this data with a deep reading of text excerpts guided by the peculiar lexicon analysis (tab. 1), three framing strategies emerge. The first, «*denial and minimization*», mainly regards C1 (fig. 1). Particularly in the initial phase, when the scientific studies which would have later demonstrated the bacterium→OQDS causal link had not yet been concluded, individuals were inclined to reject the hypothesis of such an etiological link. On the contrary, they assumed other causes to provoke the olives trees rapid desiccation, anchoring the disruptive event to notions of agronomy and folklore (e.g. pollution, fungi, and land management neglect became the most plausible causes for local farmers and online opinion leaders).

With the epidemic rapidly spreading, the «*search for the culprit*» prevails as the dominant framing strategy, fuelled by the production of an extensive wealth of conspiracy theories involving, respectively: the biotech industry, with explicit references to Monsanto (C2); the European Union, described as a technocratic institution detached from common people and influenced by «dark forces» (C3); the Italian government, and the Democratic Party, which holds the majority in Parliament and in the Regional Council of Apulia (C4).

A third strategy consists in the «*popularization of alternative knowledge*», in opposition to official protocols (i.e. the «Silletti plan», see par. 1). In other words, online users involved in these conversations (C5) support the idea that the diseased plants can «coexist» with the bacterium and be cured, instead of being uprooted.

We will further investigate this aspect in the next paragraph.

#### 4.3 *A typology of solutions by «alternative» knowledge authorities*

The last research question (RQ. 5) employs T-lab qualitative tools to search for keywords in their original context. The top ten peculiar words from each of the five clusters (see tab. 2 above) were used as pivots to read the corpus deeply in search for traces of «alternative» knowledge authorities, i.e. solutions to the OQDS other than the olive tree eradication.

More specifically, we identified two types of processes: the first consists of the re-evocation of intangible forms of knowledge passed down from one generation to another, which we decided to label as «common sense» knowledge, in accordance with quite abundant literature in the STS domain, which relates the contestation of the epistemic authority of «official» science to populism (see, to quote a few: Mede, Schäfer 2020; Harambam, Aupers 2015; Ylä-Anttila 2018; Lewandowsky *et alii* 2017; Saurette, Gunster 2011; Crabu, Magaudda 2020; Vieten 2020). The second type of process gathers protocols that – despite being utterly in contrast to «mainstream» science – can be formally thought of as «scientific» in the broader sense: in some cases, they are promoted by academics and/or biotech experts; moreover, each proposal is based on a methodological design with discrete phases in a logical consecution. Following the literature cited above, this is «counterknowledge» in our view.

A second defining criterion relates to the paths of allocation of knowledge. In one case (the «gift» mode), the proponent spreads knowledge without seeking an economic return (by choice or bound by public funding); in the

other (the «market»), the opposite occurs – for example, a discovery is industrialised, or trademarks and patents are registered.

**Figure 2** A typology of solutions to OQDS by «alternative» knowledge authorities.

		Types of knowledge	
		Common sense	Counterknowledge
Modes of allocation	Gift	A. Gift of common sense	B. Gift of counterknowledge
	Market	D. Common sense business	C. Counterknowledge business

The simultaneous application of the two criteria discussed above produces a typology of solutions against *X*. by «alternative» knowledge authorities (fig. 2).

In the first and fourth quadrant, there are traces of an ancestral, almost magical, ritual that hints at the identity-based heritage of the territory and the agricultural practice of the ancestors. In particular, three «methods» belong to the first group (*A. Gift of folklore*).

The first is the «PACE» method – *potatura* (pruning), *arieggiamento* (airing), *cenere* (ash), *erba* (grass) – devised by Giorgio Greco, a farmer active in the Lecce province, who talks about his proposal on the internet, inserting it in the wake of good agricultural practices handed down in his family (the «tacit knowledge» noted above):

«I decided to spend about 7 hours a week looking after my olive trees, after some advice from my uncle who's from the province of Foggia and came to Salento for the Christmas holidays (a couple of hours of theoretical notions on the airing of the foliage, kept in place)».

Giorgio Greco on «teatronaturale.it», August 2014

More than 400 olive trees were allegedly recovered «after a year of *traditional* and organic treatments» (our emphasis), according to the Italian newspaper «Il Fatto Quotidiano» (October 2015); the newspaper gives ample space to the second «method», called «nursing care» by its proponent, the agricultural entrepreneur Giuseppe Coppola. Intense pruning, soil care, and copper sulphate on the weaker parts of the foliage constitute suggestions arising from the enthusiasm of many online users but also generate fierce criticisms from some detractors. Interactions develop between these two groups, which, once again, end up evoking conspiracies:

«The point does not change, bacteriosis cannot be eliminated by “treating the soil” (...) these are basic notions of botanical phytopathology, (...) but feel free to believe whatever you want».

«From the “scientists” who comment on this page, I request pathogenicity tests to ascertain that the cause of the desiccation of the olive trees is XYLELLA, (...) But you don't have them, do you? Or rather, you don't wanna make them public... I wonder why».

«A bit of truth, at last, particularly from the newspapers... how is it that nobody ever said that the Xylella virus was made to disappear by some labs in Bari, and spilled on the olive trees, or that these natural treatments work better than any felling of trees? Europe wants the felling of the olive trees to favour multinationals».

online comments to Gaita (2015)

The third finding of this first group, the «*Spazi popolari*» (popular spaces) method – from the name of the association in which its advocate, the farmer Ivano Gioffreda, is active –, spreads on the internet the idea that a healthy organism physiologically develops the appropriate immune responses to cope with the disease. The online almanac «La Terra Trema», one of the most active sources in promoting it, writes, in this regard:

«We must nourish the plants if we want them to react to the disease, and so we have to nourish the land. (...) If our olive trees are still able to express so much beauty, we must thank the (f)armers who had to find out for themselves which techniques could work (...) They did this (against the policy) of explants and pesticides, which are the only responses that the State, Science (with a few exceptions), and the European Union were able to give us in the face of the spreading epidemic».

Alexik (2018)

The final quadrant (*D. Common sense business*) is pursued by the owner of a soap factory, Luigi Botrugno, who claims that his soap-based product («Nuovolivo», Italian neologism for «Newolivetree») can cure the infected olive trees by washing them:

«(the “method” produces the) re-awakening of the vegetative engine, the resistance of the attacked plants and the return of the fruit. Nature cures nature».

Botrugno (2019)

Without negating any specificities, the cases included in the remaining two quadrants (B and C) oppose phytopathological research accredited by «mainstream» scientific authorities (see, above all, Bucci 2019; Efsa 2019) without entirely disavowing scientific epistemology. To put it differently, they represent «attempts to replace established knowledge with seemingly better (but still scientific) “counterknowledge”» (Mede and Schäfer 2020: 478).

The examination of those proposals (details in *Appendix 2*, tab. A) allowed us to isolate some recursions, summarised below. The first – and, to us, the most incisive in terms of the persuasive potential of the narratives – is the writers’ background: they are (or were) part of the scientific community, their *curricula* are suitable, they work in academia or at research centres (public or private) formally certified by authorities.

Not infrequently, they boast publications in authoritative scientific journals, and their previous works have been endorsed by a qualified peer review. Online users seem well aware of the academic roots of the counter-expertise and tend to use this trait as a rhetorical element reinforcing the belief that an alternative to tree eradication actually exists. To give an example, among the numerous passages found in the empirical material:

«The alternative exists, it is practicable both on the regulatory, scientific and environmental level, (...). The study is by Prof. Mario Del Prete (Professor of Geology and Hydrogeology at the University of Basilicata (...)) and supported by another four Professors of different universities».

«Reddit», June 2017

«Among these (alternatives), that of Prof. Xiloyannis, (...) of Dr. D’Amico, (...) of Dr. Giovannetti (...) and of Prof. Marco Scortichini, (...) who, in 2018, published, after a regular peer-review which certifies its compliance with scientific and reproducibility criteria, the results of research which demonstrate...».

«YouTube», February 2019

The second point brings into the case the Italian academia, since 4 of the 9 projects that belong to groups *B*. and *C*. involve at least one university as a proponent or scientific partner.

The provision of public funds and, to an even greater extent, the registration of patents, constitutes a further distinctive status symbol, able to validate an alternative proposal:

«“Computerized” water could be the cure for Xylella. Patented by Bari-based Salvatore Rainò, (...) it has already had positive results in the treatment of chestnut trees».

«Facebook», June 2016

A fourth aspect concerns, on the other hand, content elements. The lexicon with which the «alternative» solutions are discussed on the internet recalls that of institutional disciplines (above all, quantum physics), and it is often accompanied by the will to promote the epistemic authority of the proponents with references to their spirit of inquiry and to some scientific credentials: this happens, for example, in the hypothesis of Perrino (see *Appendix 2*, tab. A) and in the «method» of computerized water (*ibidem*). In some cases, then, the proposals creep into the



online debate by disciplinary infiltration, as in the «method» of lactoperoxidase (*ibidem*), an enzyme pertinent to food chemistry translated into the field of phytopathology; in other cases, the evocative power of figures of speech, particularly analogy and metaphor, is exploited for persuasive purposes by political decision-makers and the general public (Nerlich *et alii* 2010; Larson *et alii* 2005). This is what is seen with Dentamet®, a product derived from the Scottichini «method», often presented as a «plant aerosol», based upon organic substances and therefore «eco-friendly».

## 5. DISCUSSION AND CONCLUSION

This study has intended to analyse the online debate generated by the Italian users of three social media platforms concerning the *X.* outbreak in Apulia, Italy.

Firstly, we have employed TAEC to identify popular themes (fig. 1) used by the general public to discuss the alarming event. At a later stage, the deep reading of textual excerpts from each of the five clusters that emerged from the analysis has led to the interpretation of two latent factors («conflict» and «solution») and the consequent classification of three framing strategies.

We believe that the first one («*denial and minimization*», mainly in C1 – fig. 1) is particularly eloquent of the tension between (scientific) «expertise» and (lay public) «experience», which has long questioned STS scholars (Collins and Evans 2002; Jasanoff 2003; Sorgner 2016; Archer 2015; Rip 2003; Wynne 2003). From the quotations in the previous paragraph, in fact, it emerges how the accusation of loss of credibility is used symmetrically by the various parties in the conflict; the verbalisation with which one party attempts to discredit the other is consistent with the hypothesis that the debate around the *X.* epidemic has indeed taken the form of a conflict for the monopoly of epistemic authority (Gieryn 1999; Harambam, Aupers 2015). In this regard, the «experience-based expertise» – the term Collins and Evans (2002: 251) adopt «to describe those whose expertise has not been recognized in the granting of certificates» – that a part of online users boasts expresses an argumentative strategy aimed at demarcating the epistemic field. In other words, those who appropriate it claim the right to assert their own «truth» about *X.* – i.e. «people have turned to themselves as an alternative source of knowing and understanding» (Van Zoonen 2012: 60) – even though it is incompatible with «mainstream» science. Indeed, this belief is reinforced *precisely because* it is derived from less «alienated» forms of knowledge (Mede and Schäfer 2020: 483), which are closer to the nature, history, and values of the territory.

The second framing strategy («*search for the culprit*», C2-3-4, fig. 1) draws inspiration from a science-related populist culture (Mede and Schäfer 2020) where «trust [in «official» science] is no longer self-evident» (Van Zoonen 2012: 57); indeed, the relationship between the lay public and scientific expertise is imbued with conspiracy theories and attacks against political institutions that ground their decisions on scientific knowledge.

Supporters of this view advocate «alternative» epistemologies to «institutional» science because «[l]egitimate truth-speaking sovereigns are [...] only the ordinary people themselves» (Mede and Schäfer 2020: 483), or at least some sort of «counterknowledge», which is «a knowledge complying with the general epistemology of science but produced by “alternative knowledge authorities” which are not affected by the alleged corruption of “mainstream” science» (*ivi* 479).

While some of the «alternative» solutions to the OQDS classified above (fig. 2, par. 4.3) fall into the latter category (we will return to this point a little further on), the numerous conspiracy theories that we have documented are an example of the former. Indeed, the demand for truth-speaking sovereignty is, quite often, fuelled by the *tout court* rejection of scientific epistemology (Mede, Schäfer 2020; Van Zoonen 2012), and replaced with the valorisation of the «knowledge of “the common people”» (Saurette, Gunster 2011: 199).

In short, common sense, the proximity to everyday life, and emotions are the most recurring arguments with which users legitimise the epistemic authority of «alternative» forms of knowledge in the scrutinized online documentation. Recent studies have proved the three ingredients to have an impact on other epistemic controversies, such as those involving anti-immigration debates (Ylä-Anttila 2018), anti-vaccine beliefs (Jolley, Douglas 2014),

anti-nuclear movements (Ho 2014), GMO opposition (Mintz 2017), not to mention the recent Sars-Cov-2 pandemic (Vieten 2020; Lasco 2020).

The latter strategy emerges at the intersection of the two previous ones and coagulates around a fairly wide and diverse supply of «alternative» solutions to the protocol promoted by orthodox scientific knowledge. Such heterogeneity appears to be organised, at a profound narrative level, according to two latent factors (fig. 2): the «type of knowledge» («common sense» or «counterknowledge») and its «mode of allocation» («gift» or «market»).

Moreover, the content analysis suggests that the credibility of the antagonists to «canonical» science might depend on relevant patterns of verisimilitude. Some of them pertain to the content of the messages. As we have documented, in some cases scientific terminology and methodologies are used to target the dogmatic nature of scientific assumptions made by «mainstream» science about the *X.* epidemic: «[s]cience, we may say, is at once sacralized for its intentions but demonized for its manifestations» (Harambam, Aupers 2015: 477).

Other patterns relate to the status of the producers: many of them have, indeed, roots in national academic institutions and boast publications in authoritative scientific journals. This would show, in our view, that the boundary work, and the resulting epistemic wars on the *Xylella fastidiosa* epidemic in Apulia, did not take place exclusively outside the scientific community, but also involved members and disciplines within it.

In conclusion, it is worth remarking that this study is based on an exploratory case study design, which considerably limits the scope of the results discussed above. The contribution might nevertheless pave the way for more research to verify whether and how the patterns isolated in our pilot study recur in other conflictual situations in which the epistemic authority of «orthodox» science is contested, despite their geographical and cultural specificities.

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Giuseppe Tipaldo wrote par. 2.1, 2.2, 4.1, 4.2, 4.3, 5, *Appendix 1* and 2. He also was responsible for the general research design;

Fabio Bruno co-wrote with Giuseppe Tipaldo par. 3 and was responsible for the data retrieving/cleaning/anonymisation activities and the quantitative content analysis;

Sara Rocutto co-wrote with Giuseppe Tipaldo par. 1, participated in the data retrieving/cleaning/anonymisation activities and made the qualitative content analysis.

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## Appendix 1 - Methodological note

As more briefly described in the main paper, data presented in our study are analysed relying on Computer-Assisted Text Analysis (CATA) techniques, employing two software packages: R studio and T-Lab.

Data were retrieved automatically from Reddit and Youtube while it was necessary to manually identify comments URLs due to Facebook current limitations to its graph API. In the first case, we specifically relied on the «*redditextractor*» and «*tuber*» libraries (Rivera, 2019; Sood et al., 2020). For what concerns Facebook, comments were obtained by manually downloading the files of each post, which were then processed with R Studio to anonymise and then extrapolate the individual comment (via the «*rvest*» and «*stringr*» libraries). We used R Studio also for the 2<sup>nd</sup> phase, to run the pre-processing and corpora normalizing activities: we cleaned the texts from spam, links, emojis, and words longer than 50 characters, if any. The data thus obtained were collected in a single file in .csv format.

We then moved to the T-Lab package for Computer-Assisted Text Analysis for the 3<sup>rd</sup> phase (import, assembling and lexicalisation of *corpora*). We relied on the software preset dictionaries, which have been specifically enriched over the years to pre-process the Italian language: stop-words were removed, whereas multi-words (i.e. idiomatic expressions and locutions) were identified and recorded in the vocabulary of each corpus.

In the 4<sup>th</sup> phase, we applied to the pre-processed *corpus* the Thematic Analysis of Elementary Contexts (TAEC) provided by the software, which considers as an EC every sequence of word tokens interrupted by the «full stop» (carriage return) and whose dimensions are less than 400 characters Lancia (2012); T-Lab (2021).

The main phases of TAEC analysis are presented below:

- a - construction of a «context unit x lexical unit» matrix, with presence / absence values;
- b – pre-treatment of data by TF-IDF and transformation of each row vector to length 1 (Euclidean norm); the TF-IDF measure allows to evaluate the importance of a term (lexical unit) within a document (context unit);
- c – partition of corpora in ECs (tab. A) using the cosine similarity measure (Weller and Romney, 1990) and the unsupervised clustering method «bisecting K-means» (Karypis et al., 2000; Savaresi and Boley, 2004), accordingly to the exploratory nature of the research.

*Tab. A – Key metrics of the ECs classification made by T-Labs software (N total ECs in corpus = 16,738).*

Cluster N	N of ECs classified	% total classified (% total in the corpus)
1	2,152	16.1 (12.8)
2	3,335	24.9 (19.9)
3	4,523	33.8 (27.1)
4	1,358	10.1 (8.1)
5	2,023	15.1 (12.1)
Total ECs classified	13,391	100.0 (80.0)

For each of the partitions obtained:

- d. construction of a contingency table of «lexical units x cluster» (n x k);
- e - chi-square test applied to all cross«cluster x lexical units», to have a measure of the lexicon peculiarity and minimize biases based on the researcher subjectivity when picking up text excerpts for the qualitative discussion (Krippendorff, 2004; Baron et al., 2009; Baker, 2006).
- f - correspondence analysis of the contingency table of «lexical units x cluster» (Benzécri and Benzécri, 1984; Greenacre, 1984; Lebart et al., 1998).

T-Lab's TAEC is implemented following an algorithmic logic based on a double reiteration of the process detailed below (for further details, see T-Lab, 2021; Lancia, 2012):

1. Calculation of the «Intraclass-Correlation Coefficient» (ICC-rho in table B below), which corresponds to the ratio between intercluster variance and total variance;
2. measurement of the «gap», i.e. difference between the value of the ICC-rho coefficient and that of the immediately preceding partition;
3. crosscheck of the partition results via two indexes:
  - a. the Caliński and Harabasz (1974) index, which shows higher scores when clusters are dense and well separated;
  - b. the Davies and Bouldin (1979) index, which, with an opposite logic, is based on a ratio of within-cluster and between-cluster distances and thus shows lower values when clusters are dense and well separated.
4. the production of a child partition is stopped when the gap (see point 2 above) measured after the *n-th* attempt starts to decrease;
5. After controlling for the indexes in point 3, the software by default suggests the (n-1) attempt as the best-fitting partition model from a statistical point of view.

It is worth noting that the choice of the optimal solution is also the result of an interpretation of the outputs (Lancia, 2012; Franzosi, 2008), considering qualitative aspects such as, to name a few: the semantic nature of the clusters; the theoretical justification of their spatial layout; possible overlapping among some clusters, if any.

Considering all the above mentioned quali-quantitative factors, the authors unanimously agreed to opt for the 5-partitions model highlighted in tab. B below:

*Tab. B – Key metrics of the TAEC made with T-Lab using its unsupervised clustering algorithm (N attempts = 7).*

Partitions/attempts	ICC (rho)	Gap	Caliński-Harabasz	Davies-Bouldin
2	.003	.000	-	-
3	.007	.004	45.894	48.619
4	.012	.005	52.898	21.090
5	.018	.006	61.397	10.901
6	.027	.009	74.254	6.009
7	.033	.006	76.613	4.176
Selected solution: 5 clusters Cosine similarity: .039				

Generally speaking, the TAEC is a multivariate method used to reduce the multidimensionality of one or more *corpora* to fit a Cartesian plane. To do so, data from a matrix in the form of «words x EC» are grouped into clusters on a bi-dimensional plane, where the x-axis accounts for the *inertia* of the table – which is the maximum amount of association along the horizontal axis (Weller and Romney, 1990) – and the y-axis «seeks to account for a maximum of the remaining association» (Schonhardt-Bailey, 2008: 403). In other words, this means that occurrences or clusters showing «similar distributions will be represented as points that are close in space, and categories that have very dissimilar distributions will be positioned far apart» (Clausen, 1998: 2; also see Anstead, 2018).

TAEC can be interpreted in three or more dimensions, although this study is limited to a two-factor design analysis. The axis not discussed in the main article are nevertheless reported in tab. C:

Tab. C – Thematic Analysis of Elementary Contexts (TAEC) results.

Factor	Eigenvalues	%	Cum. %
1	.227	37.44	37.44
2	.165	27.16	64,6
3	.119	19.54	84,14
4	.010	15.86	100.00

At the end of the process, the technique provides a mapping of homogeneous semantic clusters (i.e. isotopies) into which one or more corpora are divisible, and which can legitimately be interpreted as a representation of the «general or specific themes» which inform the textual material under scrutiny (Rastier et al., 2002). For our investigations, we selected as a metric the «cosine similarity» (Huang, 2008; Mihalcea et al., 2006) and the «bisecting K-means» as a partition method (Karypis et al., 2000).

Lastly, it is worth noting that the x- and y-axes are not labelled by the software. Their semantic values are abductively determined by the researcher using an appropriate theoretical framework of interpretation and argumentation (for a detailed discussion, see Cardano, 2020; a general framework for the theory of interpretation is discussed in Eco, 1992). The possibility to mix quantitative and qualitative approach in the interpretation of semantic material «is the great strength of correspondence analysis, as it has the power to reveal the underlying structure of the data» (Anstead, 2018: 294).

For a more detailed presentation of the CA family of techniques and a discussion on its practical applications, see Greenacre (2017); Clausen (1998). To have a full account on how T-Lab implements TAEC, see T-Lab (2021); Lancia (2012).

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## Appendix 2 – Alternative solutions

Tab. A The formal elements of verisimilitude of the alternative ‘solutions’ against CoDiRO (groups B and C)

<i>‘Solution’</i>	<i>Elements of verisimilitude</i>
the Perrino’s hypothesis	<ul style="list-style-type: none"> <li>- Pietro Perrino is a geneticist graduated in Agricultural Sciences, former director of the Germplasm Institute of the CNR (National Research Council) in Bari;</li> <li>- the lexicon and some contents are inspired by quantum physics.</li> </ul>
the Copagri ‘method’	<ul style="list-style-type: none"> <li>- The University of Foggia is a scientific partner, with the direct involvement of Francesco Lops, Associate professor of Plant Pathology, and Antonia Carlucci, researcher in the same scientific sector.</li> </ul>
the lactoperoxidase ‘method’	<ul style="list-style-type: none"> <li>- The Lubixyl Consortium, to which the authorship is owed, claimed to be the expression of 26 universities, 34 laboratories and 15 technical and professional organizations, from 15 countries around the world;</li> <li>- the lactoperoxidase enzyme exists and really performs antimicrobial and antioxidant activity.</li> </ul>
The Xiloyannis’ protocol	<ul style="list-style-type: none"> <li>- Cristos Xiloyannis is Full professor of Physiology of fruit species, general fruit growing and nursery techniques, University of Basilicata.</li> </ul>
The Silecc project (“Environmentally friendly control systems against CoDiRO” project)	<ul style="list-style-type: none"> <li>- Margherita D’Amico, the scientific manager, is a phytopathologist.</li> </ul>
Dentamet® or Scortichini’s ‘method’	<ul style="list-style-type: none"> <li>- Marco Scortichini is director of the Fruit Growing Research Unit of the Council for Agricultural Research (Crea);</li> <li>- Scortichini is co-author of some of the most authoritative studies on the diagnosis of CoDiRO in Puglia;</li> <li>- Dentamet® obtains a patent;</li> <li>- Dentamet® is a "biological aerosol", based on substances (zinc, copper and biocomplex citric acid) which, although ineffective on <i>X. fastidiosa</i>, are natural, as well as already accepted in the phytosanitary field.</li> </ul>
Informational water ‘method’	<ul style="list-style-type: none"> <li>- The inventor, Salvatore Riamò, is a doctor;</li> <li>- the description mimics a lexicon that, although largely inaccurate, winks at particle physics and information theories.</li> </ul>
Roveri’s ‘method’	<ul style="list-style-type: none"> <li>- Norberto Roveri, retired in 2013 as a Full professor of General Chemistry at the University of Bologna;</li> <li>- Roveri directs the Chemical Center srl, a spin off of the University of Bologna active in the microparticle sector;</li> <li>- the product based on calcium phosphate microparticles obtains a patent.</li> </ul>
BiCC project (Bio-Contrast to CoDiRO project)	<ul style="list-style-type: none"> <li>- Giusto Giovannetti, the scientific manager, is a biologist;</li> <li>- Giusto Giovannetti is the scientific director of CCS srl of Aosta, a company that has been active for 30 years in the</li> </ul>



research and production of micro-organisms for agriculture and for environmental remediation from diffuse pollution;  
- CCS srl is included in the national research register;  
- the project obtains funding from the Puglia local government.