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BEFORE THE COMMISSIONERS

AT BAY OF PLENTY

IN THE MATTER	of the Resource Management Act 1991 ("**the Act**")
AND	
IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of the hearing of submissions on The Proposed Plan Change 13 Air Quality to the Regional Natural Resources Plan for Bay of Plenty

Hort NZ

HEARING STATEMENT OF LUCY CLARKE DEVERALL

17 OCTOBER 2018

Table of Contents

INTRODUCTION

Qualifications and experience

1. My name is Lucy Clarke Deverall. I am the Environmental Policy Advisor – North Island, with Horticulture New Zealand (HortNZ). I manage HortNZ's involvement in North Island regional and district planning processes in regions where fruit and vegetables are grown commercially. I have been in this role since September 2017.

2. I hold a Bachelor in Sociology and Political Studies (2005) and a Master in Planning Practice (2007) from the University of Auckland. I am an intermediate member of the New Zealand Planning Institute (NZPI). I have eight years planning experience. During this time, I have performed the functions of a local authority planner and policy advisor and a consultant planner in various locations in New Zealand.

3. My planning experience includes preparation and analysis of land use and subdivision consent applications and presenting technical hearing evidence for both private clients and local authorities. It also includes preparation of submissions and appeals and participation in Environment Court mediations on regional and district planning matters.

4. Since beginning my role at HortNZ, I have visited growers across the North Island, including Bay of Plenty Region, to better understand their horticultural operations and how resource management issues impact them.

Purpose and scope of evidence

5. This evidence provides a statement about horticulture in the Bay of Plenty Region and how the Proposed Bay of Plenty Regional Air Plan will affect those operations.

6. In preparing this statement, I have relied on:

   (a) Planning evidence by Lynette Wharfe

   (b) Statement from Katikati Strawberry Runner Propagators

(c) Statement from Leicesters Soil Fumigation Services

(d) Statement from Kiwifruit Vine Health

7. HortNZ's perspective has been developed through consultation with New Zealand Kiwifruit Growers Inc, New Zealand Avocado's and members of Strawberry Growers New Zealand.

8. While I am a qualified Planner and member of NZPI, I am not appearing in the capacity of an expert planner to this hearing panel. My role in this hearing is as the submitter's (HortNZ's) representative and advocate.

9. This statement will focus on the key issues raised in the expert evidence and expands on the horticultural perspective to assist the Hearing Panel's understanding of what horticulture in Bay of Plenty needs to be successful and thrive.

10. Key issues addressed in the statement include:

a) Background to Horticulture New Zealand

b) Horticulture in Bay of Plenty

c) Agrichemicals

d) Biosecurity - General

e) Soil fumigation

11. Overall, HortNZ seeks that the Proposed Plan provide a regulatory environment which encourages and enables the use of appropriate mechanisms to manage environmental outcomes.

BACKGROUND TO HORTICULTURE NEW ZEALAND

12. HortNZ was established on 1 December 2005, combining the New Zealand Vegetable and Potato Growers' and New Zealand Fruitgrowers' and New Zealand Berryfruit Growers Federations.

13. On behalf of all active growers HortNZ takes a detailed involvement in resource management planning processes as part of its national environmental policy. HortNZ works to raise growers' awareness of

the Resource Management Act 1991 (RMA) to ensure effective grower involvement under the Act, whether in the planning process or through resource consent applications. The principles that HortNZ considers in assessing the implementation of the RMA include:

(a) The effects based purpose of the Act;

(b) Non-regulatory methods should be employed by councils;

(c) Regulation should impact fairly on the whole community, make sense in practice, and be developed in full consultation with those affected by it;

(d) Early consultation of land users in plan preparation;

(e) Ensuring that RMA plans work in the growers interests both in an environmental and economic production sense.

14. HortNZ manages issues that cover and affect the whole horticulture industry (excluding winegrowers and winemakers). Many of the issues are common between plans, so HortNZ provides input to policy at the national level, as well as regional and district policy processes.

15. HortNZ also undertakes work in partnership with product-specific horticultural groups aimed at developing and increasing grower awareness of environmental good and best management practice. HortNZ's website is a library resource for the many guidance documents, Codes of Practice, discussion documents and submissions that HortNZ has generated or contributed to.

16. The sector represents 5,000 growers producing around 110 crops (focused on producing food for people). Approximately, $3.44 billion is generated in export revenue annually and $2.23 billion in domestic revenue (both excluding viticulture). Over 60,000 people are employed in the industry.

17. HortNZ as the industry body is committed to continuous environmental improvement and has invested significant resource

on good management practices and the development of industry guidance and codes of practice including:

- Erosion and Sediment Control Guidelines for Vegetable Production[1]
- Vegetable Washwater Discharge Code of Practice[2]
- Code of Practice for Nutrient Management 2014[3]
- A Growers' Guide to The Management of Greenhouse Nutrient Discharges June 2007[4].

18. HortNZ supports the adoption of Independently Audited Self-Management (IASM) schemes to enable growers to meet Good Agricultural Practice (GAP)[5] standards for the management of environmental issues relevant to regional council in New Zealand.

19. New Zealand Good Agricultural Practice (NZGAP) is a certification body that is part of a network of Good Agricultural Practice (GAP) programmes around the world. NZGAP standards are best practice, relevant and internationally recognised.

20. NZGAP certification identifies the growers who have been audited and can prove they meet the requirements of the Food Act and the Health & Safety at Work Act. NZGAP are working towards achieving recognition of RMA compliance also, with an optional environmental add on to the audit. A requirement of this 'Environmental' component will include meeting codes of practice such as those mentioned elsewhere in this evidence.

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[1] http://www.hortnz.co.nz/assets/Natural-Resources-Documents/ES-Control-Guidelines-1-1.pdf

[2] http://www.hortnz.co.nz/assets/Natural-Resources-Documents/VegetableWashwaterDischargeCOP.pdf

[3] http://www.hortnz.co.nz/assets/Uploads/Code-of-Practice-for-Nutrient-Management-v-1-0-29-Aug-2014.pdf

[4] http://www.hortnz.co.nz/assets/Uploads/A-Guide-to-Managing-GH-Nutrient-Dischargesfinal.pdf

[5] https://www.newzealandgap.co.nz/

21. HortNZ is the umbrella organisation for 22 separate product groups covering 110 crops that are outlined in the Commodity Levies (Vegetables and Fruit) Order 2007. Product groups are also levy collecting organisations working on sector specific matters in collaboration with HortNZ.

HORTICULTURE IN THE BAY OF PLENTY REGION

22. Over 13,000ha of fruit is grown in the Bay of Plenty region. This is one of the largest fruit production regions in New Zealand.

23. Fruit production in the region predominately consists of kiwifruit and avocados, but also includes citrus and berries. The region also hosts some vegetables, particularly broccoli, cauliflower and cabbage. There are also a few small greenhouse operations.

24. In 2017/2018 kiwifruit covered 10,787ha of land in the Bay of Plenty region with 80% of kiwifruit in New Zealand actually being grown in the region. Bay of Plenty based avocado orchards cover 2,319ha of the region but account for 47% of the total volume of avocado's in New Zealand[6].

25. Both industries contribute significantly to the economic and social structures of the region:

- The avocado industry values at $152.1 million (2017/2018) and at peak times employs approximately 1,391 full time equivalents (FTE's) in the region.
- The kiwifruit industry contributed $650million to regional GDP 2017/2018 and employs 10,762 FTE's within the region.

26. As outlined in the attached statement, Bay of Plenty is also home to three strawberry nursery propagators who supply approximately 90% of New Zealand's strawberry runner plants. New Zealand's Strawberry industry is valued at $35million in fruit sales alone.

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[6] https://industry.nzavocado.co.nz/resources/4564666/Annual_Report_2018_Web.pdf

Food security and the role for Bay of Plenty

27. Population growth not only increases demand on housing supply, it also generates and necessitates an increased demand on food supply. There is a general assumption that New Zealand is the land of plenty and we will always have enough locally-grown food to feed our population, supplemented by imported food where there is demand.

28. But things are changing fast. Prime fruit and vegetable growing land is being squeezed by rapid growth. Increasing urbanisation places additional pressure on, and competition for, the natural resources and infrastructure also critical for growing fruit and vegetables.

29. When supply is short and demand high, prices are subject to wide variations. This can potentially make healthy food unaffordable for many New Zealanders.

30. Recent changes to land use in Auckland have seen some of the country's most highly productive land lost to urbanisation. Similarly, land use restrictions in the Waikato region are severely restricting horticultural activities. The cumulative effects of these changes will have significant consequences on New Zealand's domestic food supply.

31. This is a relevant issue as already New Zealanders, particularly vulnerable communities, are struggling to meet the recommended daily intake of 3 plus vegetables and 2 plus fruit a day. In 2016/2017, only 38.8% of New Zealand adults (15 years and over) and 51% of children met the recommended daily fruit and vegetable intake[7].

32. In particular, fruit intake for adults has declined 16% over the last 10 years. In 2016/2017, only 47.4% of children met the recommended daily fruit intake[8].

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[7]https://minhealthnz.shinyapps.io/nz-health-survey-2016-17-annual-data-explorer/_w_e9a07e83/_w_aa03fb73/_w_320818d4/_w_26fa6ce8/_w_f50ad45f/#!/explore-indicators

[8] Ibid

33. Those living in the most deprived neighbourhoods were less likely to meet the recommended intakes and were more likely to be obese[9]. A 2008/2009 study showed that "Maori females were significantly less likely to meet" the required intake than non-Maori females[10].

34. The Bay of Plenty region is the fifth largest out of New Zealand's 16 regions. It has the third highest Maori population in New Zealand.[11] The region has a higher prevalence of people being overweight or obese when compared to the national average.[12]

35. There is a fundamental need to support the long-term growth of the horticulture industry in the Bay of Plenty region. To ensure the local community has reliable, affordable access to fresh fruit and vegetables, some needs to be grown locally. This is essential for the long-term social wellbeing of the Bay of Plenty community.

AGRICHEMICALS

36. Agrichemical use is critical to horticultural growers who both use, and can be affected by other, agrichemical applications. Agrichemicals are an important part of maintaining soil and plant health through managing pests and weeds.

37. HortNZ is a member of the NZ Agrichemical Education Trust and has been involved in the development of the NZS8409 Management of Agrichemicals and the GROWSAFE training programme since its inception in 1991.

38. Key principles that HortNZ seek to have incorporated into the plan include:

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[9] Ibid

[10] https://www.health.govt.nz/publication/focus-maori-nutrition

[11] http://archive.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-about-a-place.aspx?request_value=13853&tabname=#

[12] https://minhealthnz.shinyapps.io/nz-health-survey-2014-17-regional-update/_w_b93a133a/#!/compare-indicators

- Best practice must be used in all agrichemical applications at all times
- NZS8409:2004 sets out best practice and relevant sections should be as the basis for Regional Plans
- Controls should be practical and efficient and should be related to ensuring there are no adverse effects beyond the boundary of the site where application occurs
- Training and competency of users is critical
- Clarity in responsibility of tasks and ensuring tasks can be assigned to relevant roles
- Notification is a working relationship – those likely to be directly affected have a right to know, likewise those undertaking the application need up-to-date contact details and flexibility to address the many variables involved in application.

39. The evidence of Ms Wharfe provides a detailed discussion of the use of agrichemicals in horticulture. This includes an overview of how the different training requirements interact with the RMA and details HortNZ's position regarding the planning framework for agrichemicals.

40. Of particular note in Ms Wharfe's evidence is the use of the different standards and training requirements. The training requirements under Worksafe and the Environmental Protection Authority (EPA) are very specific to the agrichemicals they address. These requirements do not cover the broader types of agrichemicals that could be used and do not apply to all instances in which agrichemicals could be used.

41. HortNZ supports the inclusion of GROWSAFE. GROWSAFE certification is required to meet market standards for most horticulture sectors. However, it is not legally enforceable for the wider community of potential users unless required by regulation or regional plan.

BIOSECURITY - GENERAL

Fumigation for quarantine purposes

42. As discussed in Mr Dyck's statement, fumigation at the Ports of Tauranga is critical practice to protect New Zealand's borders from biosecurity risks. Many biosecurity threats are not just an issue for horticulture, but have wide reaching environmental, social and economic implications.

43. For instance, the Brown Marmorated Stink Bug not only desecrates fruit and vegetable crops. It is also known to imbedded itself in houses in large numbers and destroy residential gardens. It releases an unpleasant odour and is difficult to get rid of.[13]

44. If New Zealand is unable to contain the pest effectively, it is estimated that GDP could fall $3.6 billion over 20 years and horticultural exports could fall $4.2 billion per year. Huge numbers of jobs would be lost as horticultural operations succumb to the pest incursion.[14]

45. Costs would also be incurred by New Zealand communities for damage to homes as a result of infestations.

46. HortNZ submitted in support of the proposed provisions relating to the use of fumigants for quarantine purposes. A further submission was then lodged by HortNZ in support of Hancock Forest Management to replace the word "eliminate" with wording aligned with applying best practice.

47. HortNZ supports the s42A decision to replace the word "eliminate" with "mitigate" and apply the definition to all fumigants.

Open burning

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[13] https://www.mpi.govt.nz/protection-and-response/responding/alerts/brown-marmorated-stink-bug/

[14] http://www.hortnz.co.nz/assets/UploadsNew/Quantifying-the-economic-impacts-of-a-Brown-Marmorated-Stink-Bug-Incursion.pdf

48. Burning of infected material is a method for rapid biosecurity response. For on-going management of PSA, burning is the preferred method rather than mulching as the wood chips still contained the unwanted organism.

49. HortNZ supports provisions to enable open burning for emergency disposal of diseased vegetation. However, as detailed by Ms Wharfe, HortNZ seeks additional wording to clarify responsibility of a declaration of biosecurity and ensure the responsibility allows for rapid response.

OTHER

Soil fumigation

50. HortNZ opposes the inclusion of specific provisions to control soil fumigation within the Proposed Air Plan. The Statements by the Katikati Strawberry Runner Propagators and Leicesters NZ Ltd provide more detail on the need for soil fumigation and the good management practices and technology utilised in application.

51. Soil fumigation is a fundamental practice to ensure soil and plant health. In particular, it is needed to manage soil borne disease.

52. As highlighted in the Leicesters NZ Statement, soil fumigation is a discharge to land. A machine is used to inject the fumigant into the soil, and then immediately cover the soil with Totally Impermeable Film which prevents release into the air.

CONCLUSION

53. HortNZ seeks a planning framework that enables the on-going operation and continued development of the Bay of Plenty horticulture industry and that encourages use of best practice to achieve desired environmental outcomes.

54. There is an exciting opportunity and fundamental need to support the long-term growth of horticulture in the Bay of Plenty Region and

to maximise the social, environmental and economic values afforded by the industry.

55. Key issues for horticulture and the management of air quality in the Bay of Plenty Region include:

- Enabling the use of agrichemicals in a manner that is effective in managing plant and soil health and that applies best practice to ensure personal and environmental health and safety
- Allowing appropriate mechanisms to manage environmental outcomes.

Lucy Deverall

17 October 2018

ATTACHMENT A: Statement in support of HortNZ's submission to Bay of Plenty Regional Council regarding the Regional Air Plan

We, the undersigned Strawberry Runner Propagators, would like to clarify that the annual activity of soil fumigation on our properties is not a discharge to air.

The Activity of Soil Fumigation in the Katikati area

- The fumigants Chloropicrin and 1, 3-Dichloropropene are injected into the soil to a depth of 300mm.
- This application is immediately covered, by the same machine, with a totally impermeable film and the seams sealed with glue.
- The Totally Impermeable Film (TIF) is left over the fumigated soil for up to 14 days.
- The film is then lifted and the ground worked ready for planting.
- The activity on our properties is performed once a year as a requirement of our licence agreement to propagate strawberry runner plants.
- We adhere to all the safe work practices of Leicesters Soil Fumigation Services who apply our fumigant every year.

The Necessity of Soil Fumigation in Katikati to ensure Strawberry Runner Production in New Zealand

- An estimated 90% of strawberry runner plants produced in New Zealand are grown on our properties. The strawberry fruit growers and nurseries nationwide rely on us to supply robust and healthy plants on an annual basis. We are a vital link to the entire strawberry industry in New Zealand and are affiliated members of Strawberry Growers New Zealand (SGNZ).
- Soil Fumigation is essential to combat soil borne diseases like phytophthora, and the spread of parasitic nematodes. It also helps to control weeds and ensures healthy plant growth.
- Without soil fumigation our business would be potentially unviable.

Name:_____

Business Name:_____

Experience in the industry:_____

Signature/s: _____

Name:_____

Business Name:_____

Experience in the industry:_____

Signature/s: _____

_____

Name:_____

Business Name:_____

Experience in the industry:_____

Signature/s: _____

_____

ATTACHMENT B:

15 October 2018

Statement from Kiwi Vine Health

Thank you for the opportunity to make a statement on proposed changes to the Proposed Plan Change 13 Air Quality and Consequential changes to the Regional Natural Resources Plan. Unfortunately, we are unable to attend this hearing but would be happy to address any specific questions at subsequent hearings later this month.

Kiwifruit Vine Health (KVH) is a grower funded, pan-industry biosecurity organisation dedicated to protecting the New Zealand kiwifruit industry. Kiwifruit is one of New Zealand's leading horticultural crops and an important contributor to the New Zealand economy with annual exports worth over $1.6B annually and steadily increasing. Biosecurity threats are considered one of the most significant risks to this industry.

The biosecurity system consists of a series of interventions to manage risk. The earlier interventions are applied the more effective they are in managing risk. We always strive to prevent the arrival of a pest rather than dealing with organisms once they have entered New Zealand. Treatments, such as fumigation with methyl bromide, are currently necessary to mitigate risk of biosecurity threats.

The Ministry for Primary Industries works to push risk offshore and requiring treatments before goods leave an exporting country. However, when goods do arrive with infestation it is critical that our ports of entry have systems in place to manage this risk in a quick and effective manner.

Pests are continually expanding their geographic range, a trend expected to amplify with climate change in a manner that is not always easy to predict. This was illustrated last summer with the interception of over 2000 Brown Marmorated Stink Bugs at our borders, many on vehicle carriers from Japan. As we have seen with PSA and numerous other biosecurity incursions in recent years, these threats can be devastating to our primary industries and we must have sufficient tools available to keep these out.

We must also have necessary tools to respond should these organisms enter our borders. Therefore, KVH support Horticulture New Zealand's submission to enable a biosecurity response under this Plan, namely the ability to burn infected material and the use of agrichemicals under the direction of relevant agencies such as the Ministry for Primary Industries, and management agencies such as Kiwifruit Vine Health.

KVH would be happy to attend a subsequent hearing, if the panel wish to discuss any of the above matters in further detail.

Regards

Matt Dyck
Biosecurity Manager
Kiwifruit Vine Health Inc

Updated signed copy.

Name: Keith Taylor.

Business Name: Taylor Strawberry Nursery

Experience in the industry: 50 + years

Signature/s: 12/10/18

Name: Michael Shanley

Business Name: Shanley Berry Plants.

Experience in the industry: 22 years

Signature/s: 12/10/18

Name: BRUCE RAPLEY

Business Name: KOTOJANAI FARMS LTD

Experience in the industry: 50 plus

Signature/s: 12-10-18

ATTACHMENT C:

Leicesters
New Zealand Ltd

6 Waitane Place, Onekawa
PO Box 4036, Marewa
Napier, New Zealand
Telephone: +64 6 843 5330
Facsimile: +64 6 843 5158
Email: brian@leicestersnz.com

To Whom It May Concern.

Horticulture New Zealand

Re - Bay of Plenty Regional Air plan.

12th October 2018

Soil Fumigation.

Products used for Disinfestation of Soil for Soil Borne pathogens.

Chloropicrin based soil fumigants. **Chloropicrin** does not sterilize the soil.

Chloropicrin does not deplete the ozone layer

How product is applied.

It is applied by a certified handler with a Controlled Substance License.
The application of Soil Fumigants come under the Health and Safety at Works (Hazard Substances) Regulations 2017.
We follow good agriculture Practices and Work Safe Regulation guide lines.

Chloropicrin comes in steel cylinders with a two-way valve, one for dry nitrogen, one for fluid, the product goes through a closed-circuit system on the tractor, which flow through a flow monitor and down a tube at the back of the injection shank into the soil.

Chloropicrin is injected as a liquid into the soil by a deep shank application to a depth between 30 cm to 35 cm. Immediately after treatment, the treated surface is covered with an impermeable plastic film, which prevents rapid degradation and unwanted release into the **atmosphere.**
This film is known as TIF (Totally Impermeable Film)
The treated soil remains covered for 14 days, before slicing and removal of the plastic film.

Chloropicrin does not leave residues in plant tissue or harvested produce and vegetables.

Chloropicrin before planting degrades in the soil to nitrogenous compounds and CO2, both of which can be utilized by plants.

Your Sincerely

Brian Leicester
Managing Director
Leicester's NZ Ltd.

Effects of Chloropicrin Soil Fumigation on Pathogenic and Beneficial Soil Microbial Populations in Tomato Production in EU

*J.Pecina[1], A.Minuto[2], C. Bruzzone[2], M.Romić[3]

[1] TRIS INTERNATIONAL srl, Ragusa, Italy
[2] Centro Regionale di Sperimentazione e Assistenza Agricola, Albenga, Italy
[3] University of Zagreb, Faculty of Agriculture, Department of Soil Amelioration, Zagreb, Croatia

Abstract:
Chloropicrin soil fumigation is a specific, but highly efficient mode of soil pathogens control, using specialized technology and procedures. Until recently, it was believed that, among target organisms, it has a negative effect on beneficial soil micro flora causing 'biological soil vacuum'. In 2012/2013, soil samples were taken during commercial soil treatments with fumigant chloropicrin, in 3 intensive tomato (*Lycopersicon esculentum* L.) production areas in Italy. Soil microbial population dynamics was investigated 0, 42, and 180 days after treatment, throughout the adoption of semi selective media. The research aimed to determine the effect of chloropicrin soil fumigation on dynamics of pathogenic populations of fungi and bacteria, as well as their natural antagonists from fungal genus *Trichoderma* ssp. and bacterial genera *Pseudomonas* ssp. and *Bacillus* ssp., to evaluate its efficiency with targeted organisms and to justify chloropicrin soil fumigation from an environmental and agronomic standpoint. The analyses showed detrimental effects on phytopathogenic fungi and bacteria, particularly *Fusarium* ssp. populations, while *Trichoderma* ssp., fluorescent aerobic bacteria and *Bacillus* ssp. enhanced their population density after the fumigation treatment. The obtained data i) confirms previous efficacy findings, ii) denies existence of 'biological soil vacuum effect' and might explain increase in aerial and root vigor and plant yield transplanted on fumigated soil. Furthermore, fumigant's response period, degradation and movement in the soil is determined by soil moisture, particle size and pH. To conclude, soil fumigation with chloropicrin effects target and non-targeted soil microorganisms and can be used as an advantage to create an agronomical favored rhizosphere conditions.

Key words: chloropicrin, chemical soil treatment, *Lycopersicon esculentum* L., soil borne pathogens, natural antagonists

INTRODUCTION

Modern intensive crop production in monoculture – a system with fixed and sophisticated types of controlled production area, specific irrigation and fertrigation system, as well as methods of crop protection, consequently has its specific issues. Soil degradation, draining of nutrients, heavy metal accumulation (Romić, 2009), changes within microbiological soil components, as well as physical and chemical soil properties are primary symptoms of monocultures' negative influence on the soil compounds. Furthermore, characteristic soil pathogen populations are developed for a specific crop, type of production, soil type and geo-climatic location (Shipton, 1977). Traditional plant protection methods of combating soil

pathogens have not always produced satisfactory results, especially in expanding intensive crop production systems (Maceljski et al., 2004).

Chemical measures are widespread and show acceptable results from efficiency and safety standpoints (Minuto et al., 2012). Despite efficiency, several issues such as: active ingredient resistance, negative effect on beneficial organisms and environmental fate occur regulary. Nowdays, biological measures are very popular but still insufficiently explored and highly variable.

Chloropicrin soil treatment, along with several other fumigants, represents substantial efficacy against soil borne pathogens, primarily fungi belonging to the genera *Fusarium, Verticillum, Rhizoctonia, Phytophthora, Pyrenochaeta, Pythium, Didymella, Armillaria*, etc., and therefore is the most common method of combating with the soil born pathogen problem (Aldrich et al., 1952.). The same are considered to play a major role in modern vegetable and fruit production (Locascio et al., 1997.). Together with monitoring specific parameters of soil ecology (pH, organic matter content etc.), accent needs to be put on enzyme activity as a direct indicator of functional microbial soil diversity (Nannipieri et al., 2007.). Enzyme dehydrogenase, as an indicator of overall microbial activity, is linked with microbial oxydoreduction processes (Shukla and Varma 2011.).

Until recently, it was believed that chemical soil treatment creates a 'biological soil vacuum' effect (Dick et al. 1994.).

Objective of the study was to determine and monitor the effect of chloropicrin soil fumigation in soil rhizosphere on dynamics of: target pathogenic microorganism (*Fusarium* ssp), beneficial organisms (*Trichoderma* ssp., *Pseudomonas* ssp., *Bacillus* ssp.), total organic C and dehydrogenase activity in the soil rhizosphere of tomato grown soil (Gilreath et al, 2004.).

MATERIALS AND METHODS

In order to evaluate and justify soil fumigation from an environmental and agronomic standpoint, field trials were set up and conducted in areas recognized as the most intensive tomato production in Italy during 2012/2013. Together with basic agroclimatic, agronomic and phytopathological differences, selected locations are characterized by highly commercial use of chloropicrin soil fumigation (Minuto et al, 2006.).

Active substance-fumigant is incorporated in empty soil before seeding/planting in order to suppress the soil borne pathogens, insects and weeds populations. It is conducted by specialized machines that inject the required concentration of a fumigant under pressure in the irrigation system, using water as a carrier. Immediately after treatment, the treated surface is covered with impermeable plastic film, what prevents rapid degradation and unwanted release into the atmosphere. Treated soil remains intact for 15 days what is considered to be a safety buffer period. After that, seeding/transplanting is recommended (Ministry of Health of Italy, 2010.).

Field studies have been carried out at three locations of intensive tomato production in Italy: Albenga – ITA1(light-alkal-dry soil), Ferarra – ITA2 (light-alkal-wet soil), Vittoria – ITA3 (heavy-alkal-dry soil)

Treatments:

1. Treated: 400 kg ha-1 commercial application rate of a fumigant Tripicrin (Chloropicrin 94%EC), applied at a depth of 40cm,

2. Untreated.

Soil sampling: soil samples were collected from each trial location at the depth of 20cm according to the trial programme as follows: just before the treatment from both parcels (non T and T); 6 weeks (42 days) after the treatment - 28 days after transplanting (non–T and T) and 6 months (180 days) after the treatment - 165 days after transplanting (non–T and T).

Analyses

Phytopathological analyses: Cultivation in semi selective media was used to detect CFU/g of phytopathogenic fungi *Fusarium* spp. - Komada (Komada, 1976.), phytopathogenic bacteria - Nyda, phytopathogenic fungi – PDA, antagonistic fungi *Trichoderma* spp – ELAD, fluorescent bacteria - KING-B, antagonistic bacteria *Bacillus* spp. - MUNDT (Shurtleff and Avere, 1997).

Microbiological analyses: Determination of dehydrogenase activity in the soil (Soil quality - determination of dehydrogenase activity in soil – method using triphenyltetrazolium chloride (TTC), Draft international standard – ISO/DIS 23753-1)

Physical-chemical analyses: Soil samples pretreatment for physical and chemical analysis (HRN ISO 11464:2004); Standard soil analysis to determine pH, using a 1:5 soil weight/water / 1M KCl / 0.01 M CaCl2 volume ratio using SCHOTT pH-metar Lab 870 (HRN ISO 10390:2004); Organic carbon using modified Walkly-Black procedure (HRN ISO 14235:2004); Particle size distribution using pipet-method in sodium hexametaphosphate (HRN ISO 11277:2004)

RESULTS AND DISCUSSION

Total count of *Fusarium* ssp. populations rapidly decreased in all treated samples within the first few days after treatment, and remained low throughout the study, indicating chloropicrin overall efficiency (Fig. 1). *Trichoderma* ssp. indicated expected decrease of total CFU number followed by re-colonization of superior antagonistic fungi in all treated samples, surpassing the initial CFU concentration. *Pseudomonas* ssp. were confirmed to be chloropicrin biodegrading bacteria, as its total population in soil content was immediately increased within the first two weeks after treatment. *Bacillus* ssp. populations' total count stabilized after initial high variation within treated and untreated samples - yet to confirm correlation with soil physical and chemical properties. No difference in available organic carbon forms between treated and untreated samples was observed throughout the treatment. After initial decrease in activity, enzyme dehydrogenase indicated reactivation during weeks after treatment, to reach earlier concentrations prior to the treatment, confirming stabilization in overall microbial activity. Further research needs to be done to meet observed trends in order to provide detail insight of microorganism ratio before, during and after a chemical interference.

CONCLUSION

Chloropicrin soil fumigation can be assessed as an effective chemical crop protection method to control soil pathogenic microorganisms from genus *Fusarium* ssp. Being selective to beneficial microorganisms from genera *Trichoderma* ssp. *Pseudomonas* ssp. and *Bacillus* ssp. as well as positively effecting dehydrogenase activity in the soil, it denies existence of 'biological soil vacuum' effect and can be used as an advantage to create an agronomical favored soil rhizosphere conditions in greenhouse tomato production in Italy.

LITERATURE

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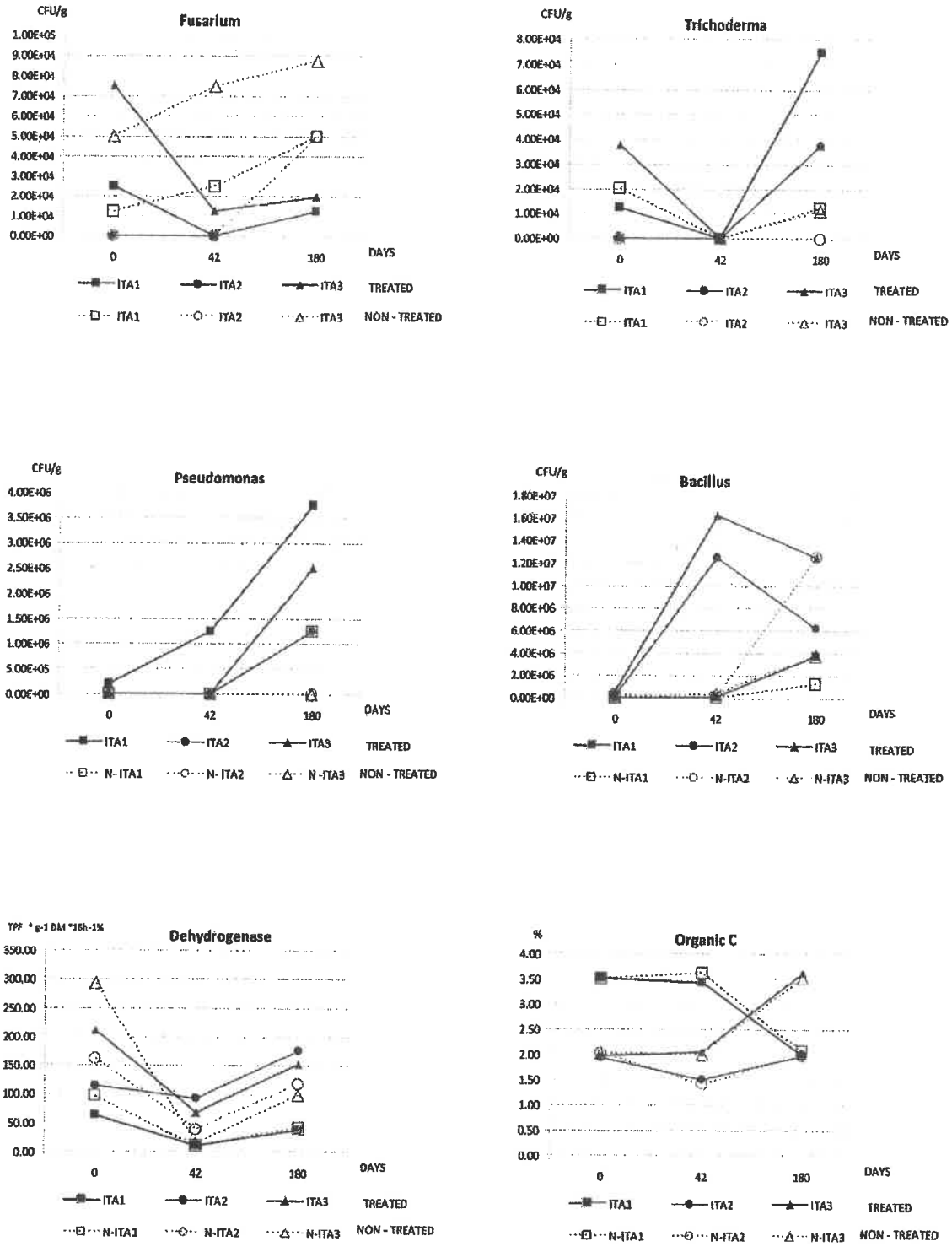

Fig 1. Dynamics indication of fungi *Fusarium* ssp., *Trichoderma* ssp. and bacteria genera *Pseudomonas* ssp. and *Bacillus* ssp. dehydrogenase activity and organic carbon respectively, within 180 days period after chloropicrin soil treatment