SPG DISCUSSION PAPER

THE FUNDAMENTAL IMPORTANCE OF PLANT HEALTH TO ONE HEALTH[[1]](#footnote-1)

(*Prepared by the CPM Chairperson*)

Abstract

Linkages between One health and plant health may be perceived by some members of the plant health community with some uncertainty and a feeling that there may not be a strong relationship between the two. Zoonoses have been the key driver for One Health. However, if One Health is intended to maximise the health of all species, good plant health is a fundamental component of One Health.

One Health definitions make direct reference to human and animal health but, for the most part, relegate other factors to “the environment”, or “ecosystems, although more prominent references to plants are emerging in some influential areas. However, plants and plant health are most frequently not specifically identified. Yet the One Health community would benefit from enhanced efforts to protect plant health. Without plants there simply is no “environment”.

Plants provide nutrition, energy and are essential in reducing hunger. They capture carbon and provide oxygen, provide other key ecosystem services, and efforts to maintain plant biodiversity will support maintaining a range of antibiotics and other medicinal compounds in the future.

There is no drawback to identifying plant health more prominently as part of One Health. By doing so the One Health approach would be strengthened significantly, to the benefit of all. In addition, a more effective and innovative approach to One Health may be realised by capitalising on collaboration by experts from diverse fields and interdisciplinary cooperation.

The general absence of specific inclusion of plant health in the One Health concept may damage plant health efforts. If the focus of decision-makers is increasingly drawn to One Health and plant health remains a secondary consideration, decisions taken by those in key leadership positions will not fully take into account the importance and needs of plant health.

If plant health is to be positioned more prominently within the One Health concept, effective advocacy and communications must be developed, and intended recipients representing the key decision-takers identified. Based on recent work conducted by the Quadripartite Governing Bodies, there appears currently to be a good opportunity for the IPPC Community to engage more actively in One Health activities and related advocacy.

1. Emergence of the One Health Concept

The World Health Organization (WHO) describes One Health as:

An integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems. It recognizes that the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and interdependent. (WHO, undated)

As the concept of One Health has developed since the 1990s, relevant linkages to plant health appear to have been perceived as tenuous and approached by some members of the plant health community with uncertainty, some with a viewpoint that there is not a strong relationship between One Health and plant health. This seems to have occurred due to the early and continued One Health focus on the relationship between animal and human diseases represented by zoonotic pathogens, coupled with the fact that plant-related pathogens directly equivalent to zoonotic pathogens are rarely identifiable (in a pathological and target host sense). Although some opportunist human and animal pathogens that are economically important plant pathogens are documented by Thornton and Wills (2015), the authors also note that “of the 5.1 million species of fungi that are believed to exist, only a handful cause [both] human and plant infections”. More commonly, some plant pathogens such as *Fusarium* spp. and ergot (*Claviceps* spp.) may have toxic and/or carcinogenic effects on mammals that consume them and others may cause allergenic or immunological problems, or result in enteric infections of mammals (Andrivon et al., 2022). Linkages between the environment (in the direct context of plant health) and human health have begun to be identified (Donovan, et al., 2013, Council of Canadian Academies, 2022), although little work seems to have been conducted or reported on this. In addition, some comments have been made to the author by plant health officials recently regarding potential allergenic aspects of plant pests (and some plants).

Evidently, the One Health concept has its origins in work involving human and veterinary health practitioners, but not plant health professionals. Morris et al. (2022) highlight novel diseases that emerged in the 1970s, including HIV and SARS, that raised a focus on the conceptual framework for the mergence and dynamics of humans and animals. The avian influenza, and similar zoonoses of the late 1990s and early 2000s, which developed into human health threats globally, made it urgent for public health and veterinary health officials to work together to consider new strategies and a framework for identifying and containing diseases at the livestock and wildlife level in order to prevent their expansion into the human population (Greifer, pers. comm.). These zoonotic events are understood to have been a key driver for the emergence of the One Health concept at the WHO and Food and Agriculture Organization (FAO) at that time. The World Organisation for Animal Health (WOAH, then known as the Office International des Epizooties or OIE) also worked closely with the FAO and the WHO to contribute expertise and provide global monitoring systems to help identify emerging disease risks in the animal sector.

In relation to this, it appears that the term “One Medicine”, representing a unified approach against zoonoses that involves both human and veterinary medicine, may have been one origin for One Health (Centers for Disease Control and Prevention, undated) and this is readily reflected in the current scope and definition for One Health. The recent COVID-19 pandemic and the potential linkages to animal origins may also increase the focus on zoonoses and diminish considerations of plant health.

2. Evolution of the One Health Concept

The scope of One Health has since evolved further to include considerations related to risks to human and animal health from the development of anti-microbial resistance, particularly related to the use of antibiotics/bactericides. In order to consider the relevance of this to plant health, the Secretariat of the International Plant Protection Convention (IPPC) undertook surveys of contracting party members to the IPPC to determine the extent of antibiotic use in plant health and the findings confirmed that antibiotics are used only in very low comparative volumes, with a narrow spectrum of products identified.

Craddock and Hinchcliffe (2015) describe One Health as “an integrated response to shared or interspecies health concerns”. It appears, therefore, that One Health has evolved to encompass other critical dimensions of environmental life which are necessary for animal and human health and survival. That environment requires the presence of plant species and provides plant resources. If, as it seems, One Health is intended to be considered as a holistic approach to maximise the health of all species and not exclusively focused on zoonotic threats, it should be clear that good plant health is fundamental to human and animal health, not least due to the role plants play in conversion of sunlight energy through photosynthesis in the production of important sources of staple foods for humans and animal populations. Human and animal life itself is fully dependent on plants and a corollary, therefore, is that human health is negatively affected by any negative impacts on plant health.

3. Where is plant health positioned within One Health?

As noted by Gray et al. (2022), One Health is a collaborative concept which acknowledges that the health of people, animals, and the environment are linked. This reflects the WHO definition which focuses on “the environment” rather than making reference to plants and plant health specifically. In 2021, the WHO’s One Health High-Level Expert Panel (OHHLEP) defined One Health as “an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems”. OHHLEP (2021) did continue to recognise that “the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and inter-dependent”. However, this definition, with such a broad reference to “ecosystems”, diminishes the key role that plants and plant health play within a One Health approach, as noted by Hoffman et al. (2022) and references cited in their paper. Loose definitions making reference to “the environment”, or “ecosystems”, when included in statements containing direct identification of, and comparison with, humans and animals are so vague that most readers are likely to focus on the identified organisms rather than considering what may be included in the terms “environment” or “ecosystem”. Realistically, both of these broad terms should be considered to include all living organisms within a given biological or environmental system (i.e., “ecosystem”) anyway. The outcome of these vague references is that plants and plant health are seemingly not specifically considered as a critical keystone component of “the environment” other than by those who work in plant health. As Andrivon et al. (2022) noted, “the One Health framework as it now stands leaves no real place for plants as organisms with their own health concerns”. This missing reference to plant health equates to a missed opportunity for the One Health community to benefit further from enhanced efforts to protect plant health which could further support and advance a truly holistic and more effective approach to global health (Greifer, pers. comm.). In addition, as Morris et al. (2022) note, although there is very little overlap in efforts to control plant diseases and diseases infecting humans and animals, plant pathology has much to learn from One health; the reverse may also be true as elaborated on by Andrivonet al. (2022).

In considering further what is meant by “the environment” when used in such definitions, it appears that it is simply a catch-all term to express “everything else”, again suggesting that, in One Health, human and animal health are the key considerations and everything else is incidental. Yet humans and animals can only exist in a broader environment and their corresponding health is a result of the conditions that prevail in that environment. And any habitable environment is based on the presence of healthy plants, i.e., the environment in which we live relies on the presence of plants. Without plants there simply is no “environment” and certainly not a sustainable environment.

More recently, plants have been recognised more clearly in some emerging communications and related plans, most notably in the definition, vision, goals, and related considerations put forward by the quadripartite governing bodies of the FAO, United Nations Environment Programme (UNEP), WHO, and WOAH (2022). However, plant health as a specific consideration remains mostly absent from the high-level actions and “action tracks” presented. Nevertheless, this action plan clearly recognises the significant interconnectedness inherent in One Health and is a significant advancement for plant health in that context. Not least, it suggests that we may be at a turning point and that the IPPC Community should take this opportunity to engage fully.

It has become clear that One Health is the present *lingua franca* of “decision-makers in several institutions, including the FAO. Notably, the FAO includes specific references to plants in its general definition on its website. However, the FAO’s publication, “National Framework For One Health” (Bhatia, 2021), refers to plants only twice in its 60 pages, both of which references are included in graphics only and with no related discussion at all on plant health beyond vague references to “environment management” and instead a complete focus on zoonoses. The importance of One Health to such institutions is so significant that it is reflected in budgets and considerations for organizational structures in some cases and yet there is little to no regard for plant health in this approach. Andrivon et al. (2022) commented that, in their literature search on the subject of One Health, despite a large number of papers identified, of 3,841 papers generated only two of these related to plant science and only one of 252 review papers taken from that group made reference to plant health at all. Plant health management is largely excluded from One Health (Andrivon et al., 2022; Rizzo et al., 2021). Even Craddock and Hinchcliffe’s (2015) paper, despite appreciating “the will to address the complexities and interrelations that exist between human, animal and ecological health” and recognising One Health as a “call for inter-disciplinarily, and the general alignment of health and other concerns”, makes no reference to plant health at all. Tellingly, they also criticise the fact that their discipline of “social science is largely relegated to communication” and recognise the “top-down assemblage” of science expertise and disciplines which is founded in human and animal health and which minimises the importance of all other relevant disciplines.

Given all of this, despite the environment being one of the components of One Health as it is currently presented, the protective aspects of One Health focus only on the human and animal aspects, not the environmental ones, and so not only are plants not considered specifically as part of One Health for their benefits, they are seemingly not considered from a disease prevention (or plant protection) standpoint either. However, for One Health to be genuinely effective and encompassing, it must include plant health specifically as a core component.

. Making the case for including plant health as a key foundation of One Health

The remainder of this paper argues that plant health should be included specifically and prominently in concepts of One Health, indeed on an equal standing with human and animal health. However, an important implication of the foregoing is that gaining appropriate recognition for the role of plant health in One Health will be challenging to say the least.

As Rizzo et al. (2021) note: “plant health is vital to sustain human and animal health and a critical component of the complex interactions among the environment, humans, and animals”. Some salient points on plants and plant health and the dependencies of humans and animals on plants include the following key linkages:

* Over 80% of human food energy comes from plants (Rizzo et al., 2021) whether directly as plant-based food and indirectly after being converted through digestion by animals. Crop losses to pests can therefore cause hunger and death through lack of food and also economic losses that may lead to reduced resources to produce, harvest, store or procure food. The need for plants is not limited to energy intake, but also includes nutrition in the form of essential vitamins and minerals which can be derived from ensuring that a diverse range of plants are included in food sources. The primary source of nutrition for livestock is plants (Rizzo et al., 2021). Plant fibre also has an important use in clothing and lumber for building materials;
* Some causal relationships between the environment in the direct context of plant health and impacts on human health have been determined. An interesting study of potential linkages between plant health and human health was conducted in Windsor, Ontario, Canada, to determine the causality of increased mortality of humans due to cardiovascular and lower respiratory tract illnesses based on the prevalence of emerald ash borer, with a causal linkage being identified (Donovan, et al., 2013). They communicate that this finding adds to the growing evidence that the natural environment provides major public health benefits.
* Almost all oxygen is provided by plants. They also help regenerate soil, filter water, and fix carbon (Council of Canadian Academies ,2022);
* It is expected that numerous bioactive plant compounds – as yet undiscovered – that may help in the management of human diseases in the future reside in biodiverse plant settings (and advances in “artificial intelligence” may facilitate more effective, targeted screening of these);
* Plants provide a natural form of carbon capture and, particularly in young forested areas, provide an important net carbon sink which aspects are essential to maintain in efforts to limit the volume of CO in the atmosphere;
* In a climate that is in a warming trend, the cooling effects of a healthy urban tree canopy will become more and more important. The same can be said in general for Northern Hemisphere albedo;
* As climate change evolves, the impacts on human and animal health are expected to increase in severity, increasing the importance of protecting plant heath to mitigate such effects.
* The use of certain chemicals to control plant pests may themselves have deleterious effects on the environment and/or mammals (Hoffmann et al., 2022); it is also apparent that some treatments, for example, fumigants, may be applied on a precautionary basis irrespective of whether the pest of concern has been confirmed to be present or not.

Summarising the above, the high-level linkages include providing adequate nutrition and reducing hunger. They capture carbon and provide the oxygen we breath (which is of self-explanatory importance) and maintaining plant biodiversity will be key to maintaining an arsenal of antibiotics and other medicinal compounds in the future.

An ironic aspect of One Health and its relationship to plant health is that the impacts of plant health are mostly driven by human activities (Andrivonet al., 2022), whether directly by spreading pests through international trade, the planting of susceptible or already infected crops (with some notable historical examples), reduced biodiversity and more prevalent planting of monocultures, or indirectly such as though the impacts of climate change; and yet the more damage to plants that occurs, the more negative impacts on human and animal health that will arise on a compounding basis. Despite all of the advances in modern plant pest and disease control, plant pests and diseases presently cause growing food crop losses of up to 40 percent (Richard, et al., 2022, Anon., 2021 and numerous online sources), becoming more significant –up to 50% – with post-harvest losses also accounted for (Thornton and Wills, 2015).

Andrivonet al. (2022) point out that “there is no essential difference in the way animal/human health and plant health issues are dealt with”, with the implication being that including plant health specifically in the concept of One Health, on at least the same footing as human and animal health, will at the very least uphold the existing approaches to pest and disease prevention and management that are currently embodied in One Health. Therefore, they continue, there is no drawback to identifying plant health specifically and increasing the focus upon it; on the contrary, by doing so the One Health approach would be strengthened significantly, to the benefit of all. Such a relationship should be seen as a prerequisite for One Health (Andrivonet al., 2022). Of interest is the observation cited by Hoffmann et al. (2022) that a more effective and innovative approach to One Health may be realised by capitalising on synergies relating to plant health, not least through collaboration by experts from diverse fields. Andrivon et al. (2022) also identify the need for interdisciplinary cooperation as a factor in addressing One Health challenges, while noting that, despite the similarities in health management solutions in many aspects of human, animal, and plant health, the literature on these subjects is rarely cross-referenced. The application of expertise in plant pathology to human enteric diseases is outlined by Brandl (2006) who describes how plant pathology has helped to develop scientific methodologies and key concepts in microbial ecology that have provided a platform on which to formulate hypotheses on the ecology of enteric pathogens on plants. Such synergies cannot be realised without specific recognition of, and a higher profile for, plant health within One Health. Hoffman et al. (2022) include in their study the potential advantages of conducting a cost-benefit analysis on actions (in their example: public investments and regulatory changes) under consideration broadly, i.e., across multiple domains. Such broad cost-benefit analyses cannot be undertaken without specific consideration of plant health in conjunction with human and animal health.

6. Recent, related IPPC discussion and decisions

It should be noted that some key points of discussion from the 2022 SPG as contained in its report[[2]](#footnote-2) are pertinent to and, to an extent, support the premise of this paper. Some relevant excerpts from the report are presented below.

The SPG considered their possible points of consensus, and the following points were suggested (in no particular order):

* The definition of One Health is problematic, but it also presents an opportunity for engagement on how plant health fits into One Health.
* The plant-health community is not yet well prepared to engage with One Health yet and so there is perhaps a need to equip the secretariat to engage more meaningfully.
* A short (two- to three-page) discussion paper or think-piece could be prepared for the CPM, outlining how the various IPPC activities contribute to the One Health agenda.”

Subsequently, the 17th Session of the Commission on Phytosanitary Measures (CPM-17) content included a paper and related discussion focused on One Health and AMR issues”[[3]](#footnote-3). The report of CPM-17[[4]](#footnote-4) also includes relevant comments and related decisions.

7. Looking ahead

The absence of specific inclusion of plant health in One Health may become damaging to plant protection and pest and disease prevention efforts (or may already have become damaging). As noted above, there appears to be an increasing focus on One Health (in its current scope) along with related organizational structure and budgetary considerations. Competing for adequate resource allocations for plant health appears to be challenging in several institutions and organizations. If the focus of decision-makers is increasingly drawn to One Health, and if plant health remains a secondary consideration or is blurred into irrelevance by its absence as a key part of the One Health concept, it seems clear that the decisions taken by those in key leadership positions will not fully take into account (or consider at all) the importance and needs of plant health.

If plant health is to be positioned more prominently within the One Health concept (ideally on an equal standing with human and animal health), effective advocacy and communications intended to position plant health more appropriately in the One Health concept must be developed, and intended recipients representing the key decision-makers identified. In this regard, the One Health Commission appears to be one obvious candidate. Also it should be noted that the 8th World One Health Congress is taking place in September 2024 and so this presents a timely opportunity potentially to submit a paper and request an agenda item to be included on the importance of plant health to One Health. IPPC Secretariat staff, and perhaps some Bureau members could participate to emphasize this.

8. Considerations for the SPG

Considerations for participants in the 2023 meeting of the Strategic Plant Group (SPG):

* What are your views on the linkages between plant health and One Health?
* Is the role of plant health in One Health more significant than appears to have been accepted to date within the One Health concept?
* Should plant health be specifically identified and highlighted in the One Health concept?
* If so, are there are any key linkages missing from the above list of linkages?
* Should the IPPC Community work to position plant health clearly within One Health and, if so, how best can this be accomplished?

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1. SPG participants may wish to review three discussion papers submitted to the SPG 2022 meetings, available at: <https://www.ippc.int/en/core-activities/governance/strategic-planning-group/2022-spg/> and also the related components of the report of the 2022 SPG meeting, available at: <https://assets.ippc.int/static/media/files/publication/en/2022/12/SPG_Oct_Report_2022.pdf> [↑](#footnote-ref-1)
2. 2022 SPG report: <https://assets.ippc.int/static/media/files/publication/en/2022/12/SPG_Oct_Report_2022.pdf> [↑](#footnote-ref-2)
3. <https://assets.ippc.int/static/media/files/publication/en/2023/01/23_CPM_2023_One_Health_AMR_2023-01-10.pdf> [↑](#footnote-ref-3)
4. <https://assets.ippc.int/static/media/files/publication/en/2023/04/CPM-17_FINAL_REPORT.pdf> [↑](#footnote-ref-4)