

# Evidence in Rebuttal

Rebuttal of written and verbal evidence presented by Dr Elaine R Ingham (written brief and presentation to the Royal Commission on Genetic Engineering, 1 February 2001).

## **Genetically engineered *Klebsiella planticola*: A threat to terrestrial plant life?**

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## **Executive Summary**

This joint statement of evidence provides rebuttal of assertions about the safety of genetic modification made in the witness brief and verbal evidence presented by Dr Elaine R Ingham, on behalf of the Green Party, and submitted to the Royal Commission on Genetic Engineering on 1 February 2001.

In this rebuttal we detail scientific issues arising from the brief of evidence and analyse conclusions drawn by Dr Ingham based on scientific results published in cited reviewed papers.

The main conclusion presented by Dr Ingham is that a genetically engineered *Klebsiella planticola* bacterium, if released into the environment, has the potential to kill all terrestrial plant life on the planet.

Her further assertion is that US authorities approved field trials involving the modified bacterium with little or no understanding of the ecological consequences and it was only as a result of independent action by herself and a student Michael Holmes that possible environmental disaster was avoided. The US authorities deny approving field trials for *Klebsiella planticola*.

Dr Ingham cites a paper: Holmes, M. and E.R. Ingham. (1999) Ecological effects of genetically engineered *Klebsiella planticola* released into agricultural soil with varying clay content. Appl. Soil Ecol. 3:394-399. to justify reaching the above conclusions. The paper cited could not be found.

It is our opinion, having reviewed the published results of the research undertaken by Holmes and Ingham, that Dr Ingham's conclusions are not substantiated by that research, and are therefore scientifically unsustainable.

Dr Ingham's assertions have been published widely on the Internet and elsewhere. However, we have been unable to find any evidence that Dr Ingham has submitted her assertions about threats to terrestrial plant life to scientific publication in a peer-reviewed journal.

Our own literature search and resulting evidence further demonstrates that natural alcohol producing varieties of *Klebsiella planticola* already exist, and are routinely found in nature; however, no adverse consequences of this alcohol production on any organisms including plants have been observed.

We are presenting this rebuttal statement because it is our strong opinion Dr Ingham has presented unsupported and inaccurate information to the Royal Commission by incorrectly interpreting published scientific information. We are therefore of the opinion that Dr Ingham's assertions have no scientific validity.

Not only are we concerned about the scientifically unsupportable and exaggerated assertions made, we are also concerned that a number of other submitters have relied on those assertions to support their own claims about the impacts of genetic modification.

### **Dr Ingham's assertions**

1. In the late 1980's a bacterium, *Klebsiella planticola*, was genetically modified to produce alcohol from post harvest crop residues (Feldmann et al, Appl. Microbiol. Biotechnol. 31: 152-157 1989).
2. Following fermentation, the residue could have been available as a fertiliser. (Ingham, witness brief)
3. Dr Ingham gave evidence that, under her supervision while an Associate Professor at Oregon State University, graduate student Michael Holmes conducted laboratory-based experiments on the genetically modified *Klebsiella planticola* bacterium, after it had been approved by the USEPA for field trials in soil with wheat plants. (Witness Brief, Exec Summ. Para 2)
4. It was claimed this work resulted in a refereed paper, cited by Ingham as: Holmes, M. and E.R. Ingham. (1999) Ecological effects of genetically engineered *Klebsiella planticola* released into agricultural soil with varying clay content. Appl. Soil Ecol. 3:394-399. (Witness Brief, Citation 1)
5. The conclusions drawn by Dr Ingham were:
  - The GM organisms killed all wheat plants in microcosms into which the organisms were added, and
  - none of the wheat plants were killed in microcosms into which the non-engineered parent organism or just water were added. (Witness Brief, Exec Summ, para 2)

Dr Ingham also stated that:

- " With a single release, we know that bacteria can spread over large distances, probably world-wide." (Witness Brief, Exec Summ, para 3)
- "The engineered bacterium produces far beyond the required amount of alcohol per gram soil than required to kill any terrestrial plant". (Witness Brief, Exec Summ, para 4)
- "This would result in the death of all terrestrial plants, because the parent bacterium has been found in the root systems of all plants where anyone has looked for its presence". (Witness Brief, Exec Summ, para 4)
- "This could have been (in the case of release) the single most devastating impact on human beings since we would likely have lost corn, wheat, barley, vegetable crops, trees, bushes, etc, conceivably all terrestrial plants." (Witness Brief, Exec Summ, para 4)

6. In her written witness statement to the Royal Commission, Dr Ingham supports her conclusions by reference to the paper (Holmes and Ingham 1999), mentioned above.

### **Assertions relied on by other persons**

7. The same reference to the Holmes and Ingham paper appears in:  
<http://www.safe2use.com/ca-ipm/01-02-05-report.htm> and in:  
<http://www.safe2use.com/ca-ipm/01-02-05-study.htm>, entitled:  
*Klebsiella planticola* – The Gene-Altered Monster That Almost Got Away.
8. Further, this paper was referenced by many others. As an example, see:  
Green Party Submission (Section B(c) 2.13 para 39), in  
Greenpeace verbal submission to Royal Commission on Genetic Modification from Dr  
Doreen Stabinski, 16 February 2001, and in  
Genetic Engineering, Food and Our Environment: A Brief Guide. Luke Anderson, Scribe  
Publications Melbourne 2000. p 49-50 describes the *Klebsiella planticola* work by scientists  
at Oregon State University. Anderson claimed the experiments showed that the bacteria were  
able to persist in the soil, and that once released would be very difficult to eliminate.

Also, the evidence was widely reported in the NZ news media with headlines like. "GM bacteria could kill all life - US expert" (Evening Post and Christchurch Press 2 Feb 2001).

### **Rebuttal evidence**

In light of the seriousness of the situation, we wish to make the following points:

#### **Non-existence of scientific paper relied on**

9. A literature search conducted by the authors and other scientists has established the paper mentioned in par. 2 as (Holmes, M. and E.R. Ingham. (1999) Ecological effects of genetically engineered *Klebsiella planticola* released into agricultural soil with varying clay content. Appl. Soil Ecol. 3:394-399.) does not exist in the scientific literature.
10. The 1999 edition of Applied Soil Ecology is Volume 11, not Volume 3.
11. Pages 394 – 399 do not exist in volume 11, which has a total of 273 pages.
12. A literature search was conducted to assess whether the paper cited by Ingham exists in another volume of Applied Soil Ecology or in another refereed journal.
13. Biological Abstracts 1995-2000 does not contain this paper. Searches on the internet (ISI's Web of Science and Entrez databases) were unsuccessful. The paper referenced by Dr Ingham could not be found.
14. When questioned in correspondence by Dr Sean Devine of the Association of Crown Research Institutes, Dr Ingham stated that the reference quoted was in error and that Michael Holmes was still working on the paper. A request for a copy of the unpublished paper has not been responded to.

15. The Executive Director of the NZ Life Sciences Network sought information to clarify the position on 5 February. (copy of email attached)

### **Assertions unsupported by research**

16. In an email response on 9 February, Dr Ingham substituted the following published scientific paper as supporting her witness statement:  
Holmes, M.T., E.R. Ingham, J.D. Doyle, and C.W. Hendricks. 1999. Effects of *Klebsiella planticola* SDF20 on soil biota and wheat growth in sandy soil. *Applied Soil Ecology*. 11: 67-78. The reply went on to state that "This paper fully supports the conclusions and extrapolations Dr. Ingham gave in her testimony. Even grade school students can follow the logic." (copy of email reply attached)
17. No further papers by Holmes and Ingham on this subject (*Klebsiella planticola*) were found despite extensive literature searches conducted by individual scientists.
18. The substituted published paper refers only to the growth of one genotype of spring wheat (*Triticum aestivum* L) in a particular type of low organic sandy soil under laboratory conditions, un-inoculated or inoculated with  $10^8$  SDF15 parental or  $10^8$  SDF20 genetically modified *Klebsiella planticola* organisms (wild type *Klebsiella planticola* was not used). Consequently, conclusions can only relate to these conditions. To make a broad generalisation, such as that made by Dr Ingham, appropriate experimental controls and more than one set of conditions should be investigated.

### **Claim that *Klebsiella* approved for field trials by EPA or USDA incorrect**

19. In her witness presentation to the Royal Commission, Dr Ingham claimed that the genetically engineered *Klebsiella* strain had been cleared by the authorities for a field trial experiment. "...field tests have already been approved by the USEPA by the time we did our research. So, this microorganism was going to be released. What is the logical outcome of releasing this engineered organism out into the real world? We have never been able to bring back from a release like this, an organism once it's released. The time we have to control is before it's released out into the real world, and yet that organism has passed all the different TSCA and USDA tests required to let it loose..." (RCGM Transcript Page 3250 35-46)
20. Further, Dr Ingham claimed that all risk analysis studies to satisfy the authorities were conducted before the application for field trial was made.
21. It appears, however, that the research referenced by Dr Ingham has never been in front of the relevant authorities in the United States. The USDA (United States Department of Agriculture) database and the ISB database (Information Systems for Biotechnology) have no mention of any field trial application or granted approval relating to any *Klebsiella planticola* research. No specific citations of docket numbers or other proof of assertion have been offered by Dr Ingham.
22. Moreover, correspondence from Dr Janet Andersen (EPA, Environment Protection Agency), and Dr Sally McCammon, Animal and Plant Health Inspection Service (APHIS) (emails attached) indicates no record of an approval for field trials of *K. planticola* as submitted by Dr Ingham (Witness Brief, Exec Summ, para 2).

### **Relevant extracts from transcript**

23. The following extract from the transcript of the Royal Commission proceedings is relevant:

*MS FITZSIMONS: ...I think perhaps - what we're talking about here, Dr Ingham, is field trials and whether field trials should continue to be allowed because they will increase our scientific knowledge. And, I think it would be useful, perhaps, if you told us what you think the effect outside the field trial plot could have been if that klebsiella field trial had gone ahead.*

*DR INGHAM: The likely effect of allowing that field trial would have been to destroy terrestrial plants, mainly because we have no way of - with the regulatory testing that's currently allowed, doesn't test for those ecological effects. We don't understand the ecology well enough, even in a laboratory quite often, to do the appropriate testing that we'd be able to predict what would happen in a field test. So, we're running such risks, by pretending that we might know what would happen in a field test, that we could unleash some really unpleasant effects on the ecology of the world.*

*So, I think there is an inherent risk, a danger that we face in allowing field tests, if we don't do a really good job of assessing what's going on in the laboratory.*

*So, we have to back up and say, "you can't let things out of the laboratory until we really truly can understand the ecology of that organism and what it could potentially do out in the real world". We don't understand that yet. It's going to be many many years before we do.*

*MR HODSON QC: Dr Ingham, as I understand it, the fact that terrestrial plants have not ceased to exist, means that the klebsiella would stop at some stage where it was still contained and able to be stopped; is that right?*

*DR INGHAM: It was not - klebsiella planticola engineered to produce alcohol was not released out in the field; the field tests were not allowed. And so, since we stopped that, we were able to keep it in the laboratory. We wouldn't want to have done the field testing under any conditions when we don't understand those organisms well enough to be able to predict what possible effect they have out in the field.*

*DR FLEMING: Dr Ingham, this is Jean Fleming from the Royal Commission speaking. Could you please describe exactly who made the discovery about the growing of klebsiella - well, what happens when wheat was grown in a field with - or in soil with klebsiella? At what stage did this happen, and was this part of the regulatory system, please?*

*DR INGHAM: The testing that was performed by Fyfra(?) - TOSKA, AFIS tests were to add the klebsiella planticola into duck food, into fish food and daphnia into the water column with daphnia; and, none of those tests indicate the effect on plants. We're not required to do that kind of testing, genetically engineered organisms.*

*So, when we came along and started adding that organism to soil so it could move into the root system of a plant, grow on the exudates actually produced by the plant, and now start making alcohol in the root system of the plant, an unexpected unpredicted occurrence happened, which was seven days after the genetically engineered klebsiella planticola was added to the soil; all of those wheat plants turned into slime.*

*DR FLEMING: Can you tell me the connection between the work required to allow this to go to field release, and the work that you've just described with the soil and the wheat plants?*

*DR INGHAM: In different types of testing the first tier of tests are those three tests that I've already described. Only if you see an impact on the ducks, or the fish, or the daphnia, would you go onto the next tier of testing.*

*DR FLEMING: I understand this, and I'm sorry to interrupt you, we're running out of time. Was it the same people who were doing the tests required for field release, that discovered the effect on plants? Or were - was your group separate to the other group?*

*DR INGHAM: My group was entirely separate from those people doing the regulatory testing.*

*DR FLEMING: Thank you.*

*CHAIR: Well, I'm sorry to come in here, but we need to clear this up. Dr Ingham; now, I'm not a scientist, and I'm not clear in my mind about this, but was what happened an unexpected result in the sense of a recombination of organisms producing a new harmful bacteria? Or, alternatively, was it a predictable result and the point is that it slipped through a gap or a deficiency in the regulatory process?*

*DR INGHAM: The organism - the ecology of the organism was not well enough understood for us to predict that effect. So, it was an unexpected, unpredicted effect until you begin to understand the ecology of that organism, and only in hindsight were we capable of understanding what happened, and now guarding against those kinds of effects.*

*This happens all the time with genetically engineered organisms, where we do not understand the ecological, environmental effect of these organisms until it's too late. We would see the same with that nematode for the possums possibly. Once it's released out there into the real world, when the field tests occurred and we got an effect on non-target organisms, would we understand, possibly, that that was not a very intelligent thing to do, allow that field test?*

*We don't understand the ecology of these systems well enough to blithely forge ahead and assume we understand what's going to happen with any of these organisms.*

*CHAIR: Yes, thank you.*

## **Discussion of scientific bases for assertions**

24. The research undertaken by Holmes, Ingham et al, which resulted in the one published paper on the effects of a modified *Klebsiella planticola* on soil biota was, however, partly funded by the EPA and reviewed by the Agency prior to publication. (ref Acknowledgements: "...The research described in this article has been funded in part by the US Environmental Protection Agency. This article has been subjected to the Agency's peer and administrative review, and it has been approved for publication as an EPA document...").

25. In our opinion, the evidence in relation to field trial applications presented to the Commission by Dr Ingham is false and misleading.
26. The abstract of the substituted paper states:

" Further investigation is needed to determine the extent these observations may occur *in situ* but this study using soil microcosms was the first step in assessing potential for the release of genetically engineered microorganisms to result in ecological effects."

This statement recognises the limitations of the study and the need for further investigation to relate the results to environmental effect in the real world. These limitations were not disclosed to the Royal Commission.
27. The parental SDF15 strain appears to be a pyruvate-formate-lyase mutant of *Klebsiella planticola*. (Feldmann et al, Appl. Microbiol. Biotechnol. 31: 152-157 1989). Pyruvate-formate-lyase is the main enzyme in enteric bacteria in the anaerobic production of organic acids. In related bacteria *Escherichia coli* (see review by J. Knappe, Chapter 13 in Vol 1 of *Escherichia coli* and *Salmonella typhimurium* Editor F. C. Neidhardt, American Society for Microbiology 1987) and such a mutation blocks a pathway for alcohol formation and causes the cells to develop extra nutrient requirements (namely acetate) as the mutation destroys the natural pathway of acetate formation. Acetate is a vital building block for the cells. In *Klebsiella planticola* this mutation demonstrably blocks natural alcohol and acetate formation (Feldmann 1989). It is therefore highly unlikely that such a mutant bacteria would have a chance of long-term survival in natural ecosystems, let alone spread across the world. As a result of its deficiency it would have a selective disadvantage in a natural ecosystem. This mutant strain of *Klebsiella planticola* was genetically modified by adding a pyruvate decarboxylase gene from *Zymomonas mobilis*. As a result, strain SDF20 has been enabled to produce alcohol, and it still retains the pyruvate-formate-lyase mutation.
28. As no wild-type control was included in the Holmes et al 1999 paper, we have no way of knowing whether or not the interference with wheat growth was merely a result of large numbers of bacteria added to the soil microcosms. A defective mutant, deficient in ability to make alcohol such as SDF15 does not help in this interpretation.
29. The study assesses the persistence of the engineered (and non-engineered) *Klebsiella planticola* in one particular type of sandy low-organic soil, over a period of 8 weeks. Also, changes in the soil flora (nematodes and wheat plants) are studied. Over the 8 week test period, the numbers of SDF15 (parental) and SDF20 (GM) in both planted and unplanted soil declined by 6 orders of magnitude (1 million-fold) indicating that these organisms are incapable of surviving under the conditions of the experiment. The survival curve did not reach a plateau by 8 weeks and when the data are re-evaluated by log<sub>10</sub>/log<sub>2</sub> plots, bacterial annihilation would probably have occurred by about 20 weeks. In contrast, active bacterial biomass did not decline significantly over 8 weeks in planted pots (Fig 2b).
30. The paper fails to address the threshold of SDF20 required for plant survival e.g. 10<sup>6</sup> SDF20 /gdw may not cause plant death and so be a safe limit to test for use as a fertiliser.
31. These facts make any conclusions that the recombinant strain SDF20 has an unusual inhibitory effect on plant growth due to alcohol formation impossible to substantiate, as the amount of wheat damage by the wild-type *Klebsiella planticola* was not evaluated.
32. Holmes et al 1999 claim that *Klebsiella planticola* exists in various soil types in nature, however they do not make reference to naturally occurring numbers of this bacterium. It is unlikely that the bacterial titer would ever be in the 10<sup>8</sup> /gdw range in nature and SDF20 at

100/gdw would be highly unlikely to be toxic to plants.

33. The claim that these GM bacteria "can spread over large distance, probably world-wide" (Witness Brief, paragraph 4) is not supported by the evidence presented in the paper.
34. Bacterial species (for example *Escherichia coli*) generally consist of strains or clones which may be adapted to particular ecological niches (ie they are ecotypes). This point is discussed authoritatively in D. S. Guttman, Trends in Ecology and Evolution (TREE) Vol 12 p16-21 (1997). In this paper Guttman discusses how ecological population structure may explain the survival of many different clones or strains in a species.
35. Hence it does not necessarily follow that because *K. planticola* has been reported world wide, that a particular strain (eg SDF15 or SDF20) will also occur in all or even many of these locations, as the species *K. planticola* almost certainly consists of many different ecotypes.
36. The claim that "these bacteria would get into the root systems of all terrestrial plants" (Witness Brief, paragraph 4) is not supported by the evidence in the paper.
37. The claim that "the engineered bacteria produces far beyond the required amount of alcohol per gram soil than required to kill any terrestrial plants because the parent bacterium has been found in the root systems of all plants where anyone has looked for its presence" (Witness Brief, paragraph 4) is not supported by the evidence. Furthermore, the GM parental bacteria, SDF15, appears to be an environmentally non-viable mutant derived from *Klebsiella planticola* (Feldmann et al, Appl. Microbiol. Biotechnol 31: 152-157 1989) and so would not be expected to form significant populations under natural conditions.
38. The claim that "This could have been the single most devastating impact on human beings since we would likely have lost corn, wheat, barley, vegetable crops, trees, bushes, etc, conceivably all terrestrial plants " (Witness Brief, paragraph 4) is not supported by the evidence. Neither does such a statement appear in the published paper by Holmes et al 1999.
39. Refer to 3.4, research around nematodes, and figure 4b:  
After 3 weeks SDF20-soil has more nematodes than SDF15-soil. At week 8 (the only other data point after week 2) it is the opposite. Also, if the lsd bar is taken into account, the differences between SDF15 and SDF 20, and un-inoculated soil, do not appear significant.
40. Based on this lack of data, any claims relating to the effects of non-engineered or engineered bacteria on nematodes are not supported by the evidence in this paper.
41. Movement of genes such as those conferring ability to produce alcohol into bacteria of the genus *Klebsiella* from other species definitely occurs in nature, so that novel bacteria analogous to SDF20 are expected to occur naturally. (see for instance Lorenz, MG & Wackernagel, W (1994) Bacterial Gene Transfer by Natural Genetic Transformation in the Environment. Microbiological Reviews, 58-3, 563-602,)
42. Just one recent example of the extensive scientific literature on this concept of gene mobility is given in a paper "Horizontal gene transfer among genomes: The complexity hypothesis", R. Jain et al. Proc. Natl. Acad. Sci USA, Vol 96 pp3801-3806 (1999), which states "The extensive amount of horizontal [gene] transfer between prokaryotes [bacteria] make it clear that horizontal transfer [i.e. movement of genes between different bacterial species] must be a major contributor to the evolution of genomes. The taxonomic breadth and extent



of transfer has been so vast that one can think of the operational gene component of prokaryotes [i.e. all known bacteria] as a single global organism.”  
This recent quotation summarises current scientifically uncontroversial consensus opinion, namely that genes readily move between different bacterial species in nature.

43. The genus *Klebsiella* is a member of the family *Enterobacteriaceae*, which includes also *Escherichia* and *Salmonella* well studied for their ability to gain and lose foreign genes. The recent paper  
“Genome sequence of enterohaemorrhagic *Escherichia coli* O157:H7, N. T. Perna et al Nature Vol409 p529-533 (2001),  
has revealed this bacterium has inherited over 1000 genes from other species. Gene movement between different genera of *Enterobacteria* can be carried out by conjugation, or bacterial mating, and by viruses that ferry genes between species. For example Table 5.2 of the advanced text “Infectious multiple drug Resistance” by S. Falkow, Pion Press 1975 gives documentation of the movement of genes between the genus *Klebsiella* and other *Enterobacteriaceae* by mating.
44. S. Falkow also states (p78) that genes are promiscuously transferred among the members of the *Enterobacteriaceae* by mating factors. Thus the mechanisms by which *Klebsiella* exchanges genes with other bacteria were well known even in 1975. The alcohol genes in SDF20 come from the bacterium *Zymomonas mobilis*. Mating between *Zymomonas* and other bacteria such as *Escherichia coli* was first reported in 1980 (see a review “Alcohol production by *Zymomonas mobilis*” P. L. Rogers, K J. Lee, M L Skotnicki and D Tribe: Advances in Biochemical Engineering Vol 23 p37-84 (1982). Feldmann et al, (Appl. Microbiol. Biotechnol 31: 152-157, 1989 (use bacterial mating between *Escherichia coli* and *Klebsiella planticola* to construct strain SDF20).
45. *Klebsiella planticola* SDF20 is genetically engineered to produce alcohol. The authors claim that this novel feature has resulted in changes in the soil microflora in their experiments, and death of wheat plants. Alcohol producing genes are present in many bacterial species and other microorganisms, and horizontal gene transfer can theoretically transfer such gene into non-engineered *Klebsiella* strains under natural conditions. As noted, horizontal gene transfer is a common process in the bacterial world, and its significance for gene exchange between species in a natural environment is an accepted concept amongst supporters and opponents of genetic engineering.
46. The amount of alcohol produced in soil microcosms by SDF20 was 20 micrograms per milliliter (as measured by Holmes et al 1999). This concentration is several hundred times lower than that required to affect plant growth (10 milligrams per milliliter), as indicated in a review by Jones, RP, Enzyme Microbio. Technol. 11: 130-153, 1989. No data are presented to support any assertion that the wilting and chlorotic effects noted on plants at 8 weeks are due to over production of alcohol rather than any of the numerous possible alternative explanations
47. At AgResearch in Dunedin, Jarvis et al. have isolated a *Klebsiella planticola* strain from red deer (Jarvis GN, Moore ER, Thiele JH (1997): Formate and alcohol are the major products of glycerol fermentation produced by a *Klebsiella planticola* strain isolated from red deer. This is a non-engineered naturally occurring bacterial strain. It has the natural capacity to produce alcohol. The authors state that fermentation of glycerol to formate and alcohol supported the growth of the bacterial culture. Glycerol can be used by the bacterium as sole carbon source. This is scientific evidence for the existence of a *Klebsiella planticola* bacterium in nature, and which is capable of producing alcohol. Further evidence of alcohol

formation is given in Feldmann et al, 1989 (Appl. Microbiol. Biotechnol 31: 152-157, who show that wild type *Klebsiella planticola* readily ferments the sugar xylose to alcohol.

48. The paper by Holmes et al 1999 has no data on competition between strain SDF20 and other bacteria in the particular environment they have chosen. No long-term studies were conducted on competition between wild type and engineered bacteria, wild type and other bacteria in the soil, or engineered bacteria and other bacteria in this soil. The presence of an extra alcohol related plasmid, by placing a metabolic burden on strain SDF20, is a prima facie reason why SDF20 might be a poor ecological competitor. These are just some reasons why the fate of the engineered strain in natural conditions cannot be extrapolated from this study.
49. Further, a natural soil ecosystem contains numerous different bacterial species, some of which can adapt to use alcohol as energy for their metabolism. In case of introduction of an alcohol producing *Klebsiella*, those natural bacteria would find an ecological niche in the said environment and would multiply. The result of such a natural balancing process would be a degradation of the alcohol produced by *Klebsiella* through other soil bacteria. Harm to plants in such case would be reduced.

#### **Dr Ingham given the opportunity but has not contradicted this rebuttal evidence**

Because of the seriousness of Dr Ingham's assertions, and in light of the various issues raised in this rebuttal evidence, we considered that it was important to give Dr Ingham the opportunity to correct any inaccuracies prior to the evidence being delivered to the Commission. Accordingly, we wrote to Dr Ingham on 16 February 2001 attaching a copy of the evidence to be presented, requesting that if we had made any factual errors, she contact us within 48 hours so that we could rectify those inaccuracies.

At the time of the delivery of this evidence to the Commission, we had received no response from Dr Ingham.

#### **Conclusion:**

In conclusion, it is our opinion that Dr Ingham has presented inaccurate, careless and exaggerated information to the Royal Commission; incorrectly interpreting published scientific information and generating speculative doomsday scenarios that are not scientifically supportable.