LITERATURE REVIEW

POTENTIAL PHYTOSANITARY TREATMENTS FOR EXPORT LOGS

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Context

- 1980s were the “high-water mark” for fumigant R&D

- Followed by a marked reduction in new fumigant development and associated research

  - Loss of ethylene dibromide - 1984
  - Increased environmental and worker safety concerns
  - Increased costs to register new chemicals
  - Increased public pressure to decrease dependence on toxic compounds
  - Decreased commercial interest in new fumigants
    - decreased scientific interest in pursuing fumigant research

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Context

- MBTOC alternatives
- NZ EPA Reassessment decision
  - Possible alternatives
- STIMBR required a review
  - Potential phytosanitary treatments
  - Specific to export *Pinus radiata* logs
  - Excluded methyl bromide and phoshine

Primary goal

- Find at least two fumigants
  - Potential viable alternatives
  - Further research

- Reviewed thirty three fumigants
  - 15 major fumigants
  - 18 minor fumigants

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Major fumigants

- Reviewed 15 significant candidates

Carbonyl sulphide	Chloropicrin	Dichlorvos
Dimethyl disulphide	Ethanedinitrile	Ethyl formate
Ethylene doxide	Hydrogen cyanide	Methyl bromide
Methyl iodide	Methylisothiocyanate	Nitric oxide
Ozone	Phosphine	Sulfuryl fluoride

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Minor fumigants

Reviewed 18 candidates:

Acetaldehyde	Acrylonitrile	Azobenzene
Carbon bisulphide	Carbon monoxide	Dichloronitroethane
Ethylene chlorobromide	Methyl allyl chloride	Methyl chloroform
Methylene chloride	Naphthalene	Nicotine
Methyl formate	Paradichlorobenzene	Propylene dichloride
Sulphur dioxide	Tetrachloroethane	

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Secondary goal

- In-depth review of potential non-chemical treatments and methods including
  - Controlled and modified atmospheres
  - Energy treatments
    - Irradiation
    - Microwave
    - Electric current
    - Infrared
  - Physical treatments
    - Cold / heat
    - Pressure / vacuum,
    - Other alternatives
      - debarking of logs
      - pest management systems
      - systems approaches.

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Considerations

- Review - specific to treatments against forest species associated with *Pinus radiata*

- New Zealand does not have any nematode or pathogen issues of quarantine importance with export logs

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Considerations

Treatment schedules specify treatment parameters that must be followed to ensure treatment efficacy and quarantine security for example:

- **Fumigation schedules**

  specify the fumigant concentration, the temperatures at which the fumigation must be carried out, and the duration the treated material must be exposed to the fumigant.

- **Physical treatment schedules**

  such as cold or heat treatments, specific the temperatures that must be used and the treatment time or duration for which the material must be subjected to the specified temperature.

- **Energy treatments**

  such as irradiation, specify the amount of radiation energy that must be absorbed at the center of the treated material.

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Fumigants - evaluation parameters

- Physical and chemical properties
- Mode of insecticidal action
- Availability
- Environmental credentials
- Health and safety requirements.
- Potential synergistic combinations based on mode of action
- Enhancing treatments that can be incorporated at operational scale evaluated for potential benefits, e.g., heat, modified oxygen (O2) and carbon dioxide (CO2).

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Review findings

Non -chemical options

Debarking	More expensive logistically challenging	Study completed; all potential alternative chemical or non -chemical methods must be compared with debarking
Heat - hot water or steam	Very expensive and logistically challenging	No research in progress; may have niche potential
Heat - Joule heating	Concept proven	Niche potential
Microwave	Expensive, but possible	Approved for use on wood packaging internationally but unlikely for logs
Irradiation		May have niche potential
Water soaking	Untested	Logistically difficult; considered and discounted
Integrated pest management	Initial research completed	Already used in horticulture; may only support a decreased need for fumigation during periods of insect inactivity; will require pest -monitoring programs

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Review findings -fumigants

- ***<u>NO</u> NEW PREVIOUSLY UNKNOWN FUMIGANTS***

- ***<u>NO</u> "SILVER BULLETS***

Review findings –FUMIGANTS

Chemical options

Fumigant	Compared with methyl bromide	Status and/or comments
Carbonyl sulphide	Less toxic	Considered, but less effective
Ethyl formate	Less toxic	Being tested for horticultural crops but unsuitable for logs
Methyl iodide	Toxic and carcinogenic	
Methylisothiocyanate	More toxic	Considered and discounted
Sulfuryl fluoride	A green house gas	A distant second to EDN if no other fumigants are available for logs
Ethanedinitrile	Equivalent toxicity	Promising for sawn timber and logs

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Review findings

Except for ethanedinitrile

the review found

No additional viable fumigant alternatives

to methyl bromide

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Ethanedinitrile - EDN

A potential alternative phytosanitary treatment for logs

- Techno-economic study completed
- Confirmed no significant technical issues to prevent pursuing EDN as an alternative export log phytosanitary treatment
- EDN efficacy data for three forest insect species is being developed

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