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Managing food safety of leafy green vegetables before harvest

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Ensuring food safety of leafy green vegetables

Leafy green vegetables (LGV) are an important component of a healthy diet, providing essential nutrients that can help prevent chronic diseases. In the past 5 years, Australian production has increased by 40% to nearly 79 000 tonnes per year (valued at $600 M). However, LGV are susceptible to contamination by human pathogens. Industry currently relies on food safety management plans to manage food safety risk. These plans are implemented as best agronomic practices in the field and washing including sanitisers after harvest. This project will review both the published literature and current industry practices to report the feasibility of sanitising irrigation water and/or crops in the field to prevent pathogen transfer from the field to the packhouse and to reduce the risk to the consumer.

Sources of microbial contamination

Contamination of LGV in the field can originate from the faeces or carcases of wild and domestic animals including birds. They can contaminate plants directly, or indirectly from soil splash, water and dust. People can also pose a risk through direct contact with the LGV in the field or at harvest. *Post-harvest sanitisation* alone, cannot be relied on to fully eliminate pathogenic microorganisms on field grown leafy vegetable crops.

Pre-harvest factors that influence the risk of contamination

- Environment - temperature, rainfall, humidity, wild and domestic animals
- Production system - conventional or organic
- Vegetable species and variety - plant shape and form
- Agronomic practices such as crop rotation, fallowing, soil management, pesticides, direct sown or transplants
- Water management and irrigation systems (whether overhead or drip, water quality and quantity or rainfed)
- Nutrition management - use of organic and animal manure, compost and amendments and inorganic fertilisers
- Harvest system - mechanical harvesting or manual
- Post-harvest treatment in paddock - sanitiser, transport and storage
- **New and emerging sanitation technologies?**

KEY POINTS

- **Leafy green vegetables are susceptible to microbial contamination as they are often eaten raw.**
- **Minimising pathogen contamination in the field is critical.** The study will compile and review the best agronomic practices and protocols to minimise risk of pathogen contamination pre harvest.
- **Feasibility of using pre-harvest sanitisers will be examined in a 'desktop' review and in consultation with industry.** The study will evaluate the benefits and economic viability of applying chemical-based sanitation through spray or irrigation water to leafy green vegetable crops in the field.

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Do sanitisers in irrigation water reduce microbial load in the water and on the crop?

The first step in reducing this risk is to remove the source of contamination This can be difficult as soil movement can easily occur as dust blown by the wind, by rain splash or by roaming animals or birds.

Can we reduce the risk of contamination by sanitising the crops in the field using treated irrigation water or sanitation sprays?

This is a possible strategy though not currently widely used in Australian industry.

It is technically possible, but is this option feasible or even advisable?

There is a very little information about the efficacy of pre-harvest sanitation on the crop. However, we can draw from findings of numerous studies that have examined the key physical and chemical factors that influence the efficacy of sanitisers to decontaminate irrigation water including sunlight, organic matter, pH, presence of salts, and exposure time.

Knowledge gaps of applying preharvest sanitation – lots of unknowns!

Questions still to be answered

- Cost-benefit of pre-harvest water treatments
- Chemical usage efficacy
- Impact on natural microbial and plant pathogen populations
- Effect of sanitiser residuals on long-term soil and ecosystem health from multiple applications
- Regulatory framework for pre-harvest use of sanitisers is largely absent
- Potential impact of preharvest treatments on food safety outcomes

***Table 1* Estimated cost of four common sanitisers if applied in irrigation water** (Does not factor the cost of water as water is already used for irrigation)

Sanitisers	Recommended level (ppm)*	Cost per ha**	Capital costs
Chlorine	25-80	$417 -$1336	
Peroxyacetic acid	20-80	$448-$1792	
Electrolysed oxidising water	2-20 (as free Cl)	$8-$75	$37K for a generator
Nylate	5-10 (as free Cl)	$194-$388	$850-1200 for an erosion feeder

*higher end of the recommended level is based on postharvest conditions.
**assuming that 300,000 L is used per ha.

Estimated cost-effectiveness of four common sanitisers

We propose that the sanitiser will be applied once just prior to harvest as a final 'rinse' either in the irrigation water or delivered in a similar way to pesticides. Based on recommended commercial dosage rates applied at post-harvest, we can roughly calculate the cost-effectiveness of four commonly used post-harvest sanitisers (Table 1, above).

New recommendations for industry

This project will provide recommendations on practical solutions and further R&D needed to optimise pre-harvest protocols and sanitation for different crops and growing situations.

The economic analysis will enable growers to assess the cost benefit of pre-harvest sanitisers based on their individual business model.

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