



TEMPWAVE™ CROP FREEZING AND FROST PROTECTION SYSTEM QUESTIONS & ANSWERS

Q. What is Tempwave™?

A. Tempwave™ is a system (patent pending) that uses low-level microwave radiant heat to prevent frost damage to crops.

Figure 1. A Tempwave™ tower being tested on a vineyard plot at Vineland Research and Innovation Centre. The tower is approximately 25 ft tall and powered by grid electricity.



Figure 1.

Q. How does Tempwave™ work?

A. Tempwave™ radio wave energy is transmitted from towers located in an orchard or vineyard changing the energy balance that slows cooling to prevent freeze damage. The Tempwave™ radiant heating system emits low powered radio waves tuned specifically to water molecules causing them to vibrate and heat up just enough to keep from freezing, similar to a microwave oven. The energy is delivered directly to the crop without heating the intervening air.

Q. How will Tempwave™ protect orchards and vineyards?

A. Tempwave™ has the potential to be an alternative frost protection tool for growers of grape, apple, stone fruit and berry crops. This technology will add to the arsenal of wind machines, heaters, sprinklers, and covers in managing frost and freezing threats.

Tempwave™ does not rely on environmental conditions for its effectiveness. Tempwave™ does not use water, does not emit smoke and is silent in operation.

Q. Has Tempwave been used in other vineyards and orchards?

A. Yes. Initial proof-of-concept testing on citrus crops in California using Tempwave™ powered by grid electricity demonstrated protection of orange groves from frost damage.

Q. What are the savings to farmers, growers and the economy in using Tempwave™ in Ontario orchards and vineyards?



A. Historically in Ontario, significant winter damage occurs approximately 1 year in every 10. However, the winters of 2003, 2004 and 2005 all had sufficiently cold temperatures resulting in damage to vine and tender fruit trees.

In particular, the high quality *vinifera* grapes used in Ontario are sensitive to cold injury from early Fall to the last frost in the Spring. In 2005 there were just over ten million *vinifera* vines in Ontario (approximately 66% of total commercial vines in Ontario). Temperatures in January of that year resulted in a reduction in overall yield of processed grapes by 54% (56,787 tonnes in 2004 to 26,198 tonnes in 2005), mainly due to winter injury. Tender fruit crops also suffered crop reduction, especially peaches. (Source: OMAFRA)

Q. Are there any safety concerns regarding the use of Tempwave™?

A. The main effect of radio frequency electromagnetic fields on humans is the heating of body tissues. Exposure standards for radiofrequency fields and microwaves are set to prevent health effects caused by localized or whole-body heating. Compliance with the Health Canada's *Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz* (Safety Code 6) during the use of Tempwave™ will ensure human safety.

Tempwave™ is not considered a radio apparatus by Industry Canada therefore does not require a radio licence for use. To be commercialized, Tempwave™ must be in compliance with Canadian Standards for Industrial, Scientific and Medical (ISM) Radio-Frequency Equipment per Industry Canada.

Q. What are the terms of the Raytheon/Vineland Research and Innovation Centre agreement?

A. Vineland Research and Innovation Centre has entered into a co-development/co-marketing agreement with Raytheon Company which will see the installation of a prototype freezing and frost protection system for testing purposes on a small vineyard plot at the Centre.

Vineland is researching this new and innovative technology on behalf of Canadian horticulture and field crop growers. This initial investment will provide scientific evidence of the value of Tempwave™ in horticulture operations. It is anticipated that positive field trial results will lead to expanded testing, potentially including additional crop types, and development of a commercial product.

Funding for this work was provided in part by Agriculture and Agri-Food Canada and the Ontario Ministry of Agriculture, Food and Rural Affairs through the Innovation and Science Suite of programs under Growing Forward, a federal-provincial-territorial initiative.

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