

## **On the horizon: New tools for addressing root-knot nematode challenges in California's carrot production**

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### **Summary**

UC ANR research demonstrated that novel contact nematicides with favorable safety profile are as effective or better than the previous generation of highly toxic non-fumigant carbamates and organophosphates. They are likely to reduce soil fumigant use against root-knot nematodes (RKN) in carrot production, ensuring the industry's economic viability.

### **Background**

In 2019, California growers produced 88% of the US fresh market carrots. Nearly 45% of the 71,000 acres were treated with soil fumigants to reduce plant-parasitic nematodes, primarily RKN. They induce disfiguring forking and galling of the roots that often result in unmarketable produce. While soil fumigants effectively mitigate such damage, they are potential environmental and human health hazards. Their use will be increasingly difficult and costly by regulatory restrictions. Currently, all commercial carrot cultivars are susceptible to RKN. Crop rotation with nonhosts is not sufficiently effective due to the nematode's broad host range, the large RKN reproduction potential, and the low damage threshold.

### **The Research**

During the past decade, we installed and maintained uniformly infested RKN (*Meloidogyne incognita*) testing sites on sandy-loam fields at UC Research and Extension Centers at Irvine and Reedley, and at a research farm near Shafter. It allowed testing various biological and synthetic nematicides at high disease pressure. The RKN soil population was monitored before and after each trial by soil sampling, nematode extraction, and enumeration with the aid of a dissecting scope. Midseason plant vigor and fibrous root galling, harvest tap-root galling, and marketable carrot yield were determined and statistically analyzed. All test products were evaluated for 3-4 years and compared to commercial nematicides and an untreated control. After years of insufficient efficacy by various development products, three new nematicides with novel mode-of-action consistently outperformed all other test materials at high RKN population densities and severe disease pressure [1].

### **The Impact**

Once registered by the U.S. Environmental Protection Agency and the California Department of Pesticide Regulation, the new nematicides will be useful tools for mitigating RKN problems in carrots and likely many other crops. Together with their favorable toxicological and environmental dossiers, they are examples of a much-improved next generation of nematicides. Signal words on a pesticide label indicate the relative hazard level. The previous generation of nematicides typically had the signal word "Danger," used for the most toxic products.

It is anticipated that each of the new products will have as the signal word "Caution," the lowest hazard level, also found on organic products such as citric acid or *Bacillus thuringiensis*. The long-term impact of this research is that the carrot industry will have effective low hazard alternatives to replace soil fumigants for mitigating RKN problems, especially considering increasing regulatory restrictions and costs related to soil fumigants. These outcomes demonstrate how the research contributes to increased agricultural efficiency and profitability, and the public value of promoting California's economic prosperity.

### A Clientele Quote

"The UCR/UCANR scientists' research and outreach are highly appreciated by the CFMCB, the project's primary sponsor." - Nathan Sano, Manager, California Fresh Market Carrot Advisory Board

### Literature

[1] Becker, J.O., A. Ploeg, and J.J. Nuñez 2019. Multi-year field evaluation of fluorinated nematicides against *Meloidogyne incognita* in carrots. *Plant Disease* 103:2392-2396. Doi:10.1094/PDIS-03-19-0489-RE



Fresh market carrots from a root-knot nematode-infested field trial. Carrots from an untreated plot (left) and from one treated preplant with a non-fumigant nematicide (right).

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