Population Fluctuations of Ring Nematode (*Mesocriconema xenoplax*) in Prune Orchards in California

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Abstract

Sampling of ring nematode for three years in five California prune orchards indicated that peak nematode numbers occurred during the summer at or shortly before harvest with a rapid decline thereafter. Additional smaller peaks occurred in the winter and fall. Samples were taken at soil depths of 0 to 30 cm and 30 to 60 cm. The number of nematodes appeared to be greater at the 0 to 30 cm depth in the summer months with greater numbers being present at the 30 to 60 cm depth in the fall and winter. Nematode numbers were lowest before irrigation and sharply increased after irrigation. No differences in nematode recovery were evident between sampling with a shovel, a 5-cm diameter auger, or a 2.5-cm diameter tube. The optimum strategy for sampling to determine if ring nematode is present in a prune orchard would be: 1) at a depth of 0 to 30 cm, 2) shortly after an irrigation, 3) between June and August, and 4) with either a shovel, an auger or a sampling tube. Samples taken in the fall and winter were more likely to detect the presence of ring nematode if they were taken from 30 to 60 cm deep than at shallower depths.

INTRODUCTION

Ring nematode (*Mesocriconema xenoplax*) is thought to be the most damaging nematode in prune orchards in California and reduces prune yields through root damage from direct feeding and by placing trees under stress which predisposes them to bacterial canker (*Pseudomonas syringae*) infection (UC IPM Online, 2009). Sampling of 97 prune orchards by B.F. Lownsbery in 1974 indicated that 67% of the orchards were infested by pin nematode (*Paratylenchus* sp.), 62% by dagger nematode (*Xiphinema americanum*), 38% by ring nematode (*Mesocriconema xenoplax*), and 7% by lesion nematode (*Pratylenchus vulnus*) (McKenry and Westerdahl, 2012). Field trials were conducted in Butte, Colusa, Glenn, Sutter, and Tehama counties to optimize sampling strategies and post-plant treatment timing for ring nematode on prunes.

MATERIALS AND METHODS

Monthly sampling sites were established in orchards located in Glenn, Tehama, Butte, Colusa, and Sutter counties and evaluated monthly over a three-year period. In Colusa, Glenn and Tehama counties, four soil samples per orchard were taken monthly with a 2.54-cm diameter Oakfield (Oakfield Apparatus, Inc., Oakfield, WI) soil sampling tube with one sample consisting of 5 soil cores. When soil conditions permitted, separate samples were taken from the 0 to 30-cm and 30 to 60-cm depths. The orchards in Butte and Sutter counties had soils not conducive to sampling by this method, and were sampled with a trenching shovel (13 cm wide x 25 cm long blade) to a depth of 30 cm.

Gravimetric soil moisture was determined for each sampling date and depth. Soil types were determined by the UC DANR Analytical Laboratory to be: Butte (clay loam, 28% sand, 45% silt, 27% clay, 1.81% organic matter), Colusa (silt loam, 14% sand, 68% silt, 18% clay, 1.49% organic matter), Glenn (sandy loam, 64% sand, 25% silt, 11% clay, 0.89% organic matter), Sutter (loam, 37% sand, 45% silt, 18% clay, 1.46% organic

matter), and Tehama (loam, 38% sand, 49% silt, 13% clay, 1.81% organic matter).

On five occasions, samples were taken with multiple sampling instruments (tube, shovel, or auger) to compare the number of nematodes recovered with the different sampling tools. The auger used was a 5-cm diameter bucket auger (Soilmoisture Equipment Corp., Santa Barbara, CA). Sampling was conducted in Tehama County in July (tube and shovel) and August (tube, shovel and auger); in Colusa County in January (tube, shovel and auger), and August (tube and shovel); and in Glenn County in August (tube and shovel).

On four occasions, samples were taken just prior to irrigation, and from 2 days to 4 weeks after irrigation to assess the effects of soil moisture on nematode recovery. In Sutter and Butte counties, sampling took place with a trenching shovel one day before; and 2-days, 2-weeks, and 4-weeks after irrigation. In Glenn and Tehama counties, sampling took place with an Oakfield tube one day before; and 4-days, and 2-weeks after irrigation.

For all studies, nematode extraction was by elutriation followed by sugar centrifugation (Byrd et al., 1976). Extracted nematodes were then counted under a microscope. Monthly sampling data were analyzed by repeated measures ANOVA followed by Fisher's Protected Least Significant Difference Test ($P = 0.05$). ANOVA did not reveal significant differences between orchards, so the data were pooled for a combined analysis. Data for the other studies were analyzed with ANOVA followed by Fisher's Protected Least Significant Difference Test ($P = 0.05$).

RESULTS AND DISCUSSION

Sampling of one prune orchard in each of five counties periodically during a three year period, indicated that ring nematode populations were highest at or shortly before harvest in the summer with a rapid decline thereafter (Fig. 1). Additional smaller peaks occurred during the fall and winter. The number of nematodes appeared to be greatest at the 0 to 30 cm depth in the summer months with greater numbers present at the 30 to 60 cm depth in the fall and winter. At 0-30 cm, nematode populations in July were greater ($P=0.05$) than at other times of the year, except for June and August. At 30-60 cm, nematode populations in July and October were greater ($P=0.05$) than those in January or December.

When percent soil moisture at each sampling date was averaged for the three year sampling period, at both 0-30 and 30-60 cm depths, nematode population levels were negatively correlated with percent soil moisture. At 0-30 cm, the relationship was: $y = -257.43x + 7146.2$, $R^2 = 0.4578$, $P=0.0157$ where x = percent soil moisture, and y = population of ring nematode. At 30-60 cm, the relationship was: $y = -205.78x + 6346.6$, $R^2 = 0.2546$, $P=0.0943$, where x = percent soil moisture, and y = population of ring nematode.

Ring nematode was consistently recovered with all three of the sampling implements (Figs. 2-4). On four of five occasions, numerically, more nematodes were recovered at 0-30 cm than at 0-60 cm when sampled with the tube. Also, on four of five occasions, numerically, more nematodes were recovered with the shovel than with the tube. On the two occasions when the auger was used, numerically, nematode recovery was lower than with a shovel or the 0-30 cm depth with a tube.

In the Sutter and Butte county orchards that were sampled with a shovel (Figs. 5 and 6), numerically, nematode populations were lowest just before irrigation, then increased by 2 days to 2 weeks after irrigation, and were low again 4 weeks after irrigation. The same trend occurred in Glenn and Tehama counties that were sampled with a tube at 0-30 and 30-60 cm deep. Nematode numbers were lowest just before irrigation, and higher at four days and two weeks after irrigation.

CONCLUSIONS

The optimum strategy for sampling to determine if ring nematode was present in a prune orchard was: 1) at a depth of 0 to 30 cm; 2) shortly after an irrigation; 3) between

June and August; 4) with either a shovel, an auger or a sampling tube. Samples taken in the fall and winter were more likely to detect the presence of ring nematode if they were taken from 30 to 60 cm deep than at shallower depths.

ACKNOWLEDGEMENTS

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Literature Cited

Byrd, D.W.Jr., Barker, K.R., Ferris, H., Nusbaum, C.J., Griffin, W.E., Small, R.H. and Stone, C.A. 1976. Two semi-automatic elutriators for extracting nematodes and certain fungi from soil. J. Nematology 8:206-212.

McKenry, M.V. and Westerdahl, B.B. 2012. Plant-parasitic nematodes. In: R. Buchner (ed.), Prune Production Manual (Chapter 19). UCANR Publication Number 3507.

UC IPM Online. 2009. UC IPM Pest management guidelines. Prune Nematodes. Statewide Integrated Pest Management Program. Agriculture and Natural Resources, University of California. http://www.ipm.ucdavis.edu/PMG/r606200111.html [accessed 14 July 2012].

Figures

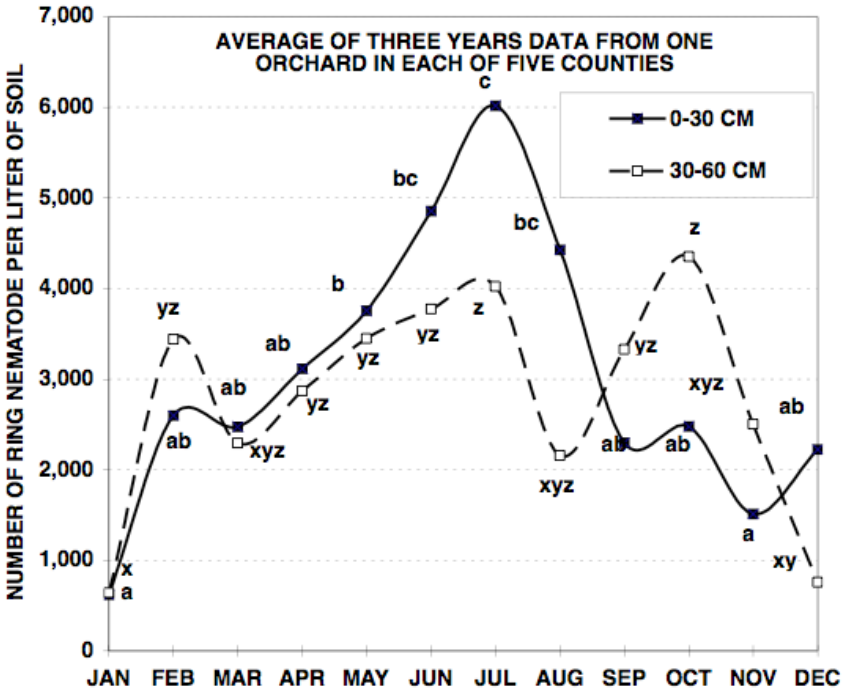

Fig. 1. Population fluctuations of ring nematode at 0-30 and 30-60 cm depths. At each depth, points not followed by the same letters were significantly different from each other at *P=0.05*.

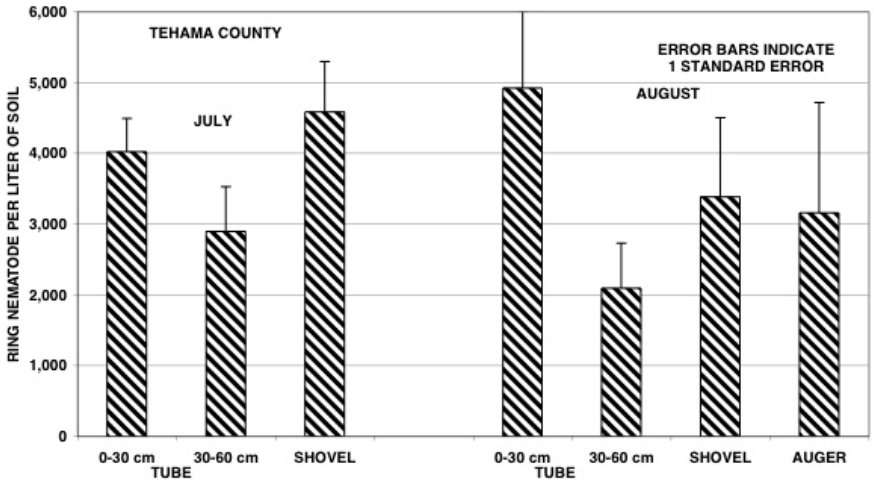

Fig. 2. Populations of ring nematode recovered with different sampling instruments in Tehama County on two sampling dates.

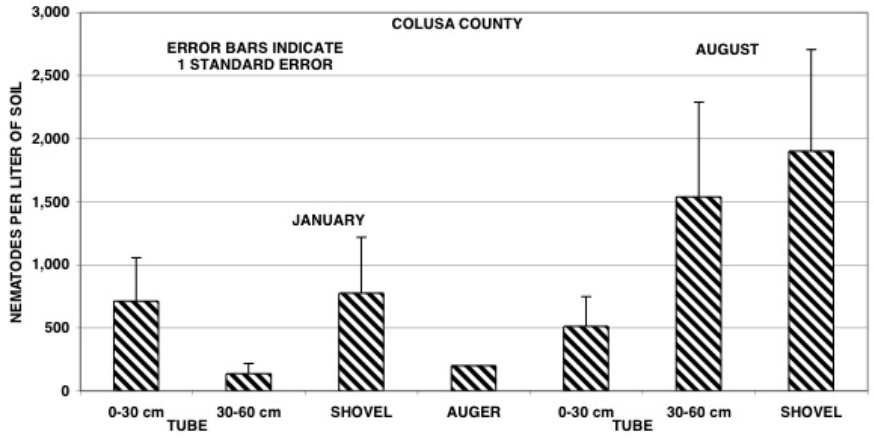

Fig. 3. Populations of ring nematode recovered with different sampling instruments in Colusa County on two sampling dates.

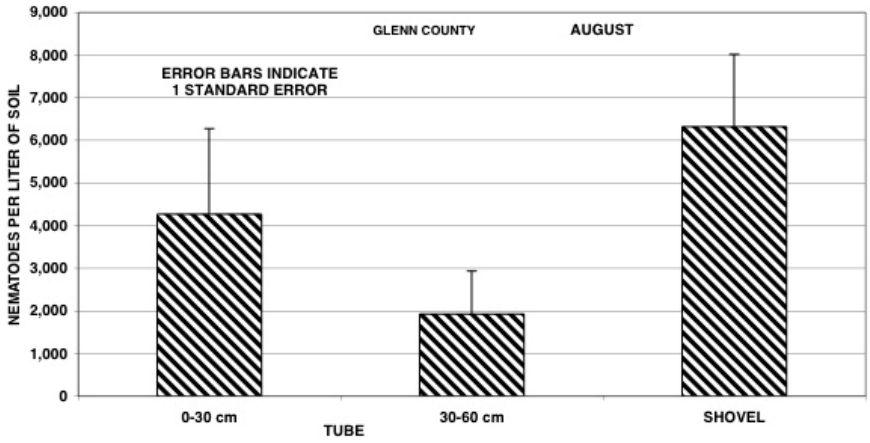

Fig. 4. Populations of ring nematode recovered with different sampling instruments in Glenn County.

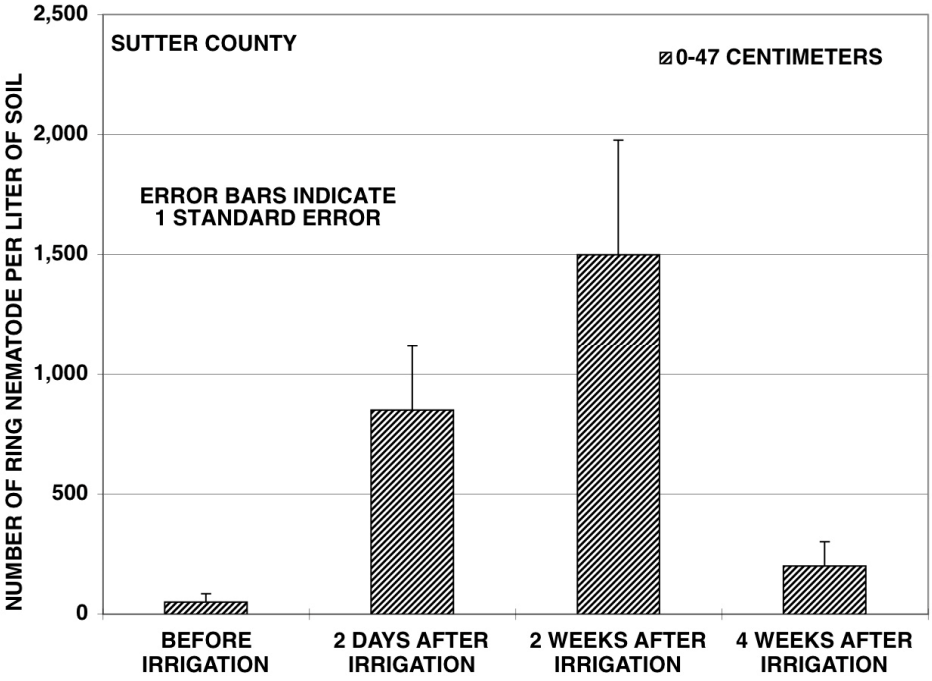

Fig. 5. Populations of ring nematode recovered before, and at three dates following irrigation in Sutter County.

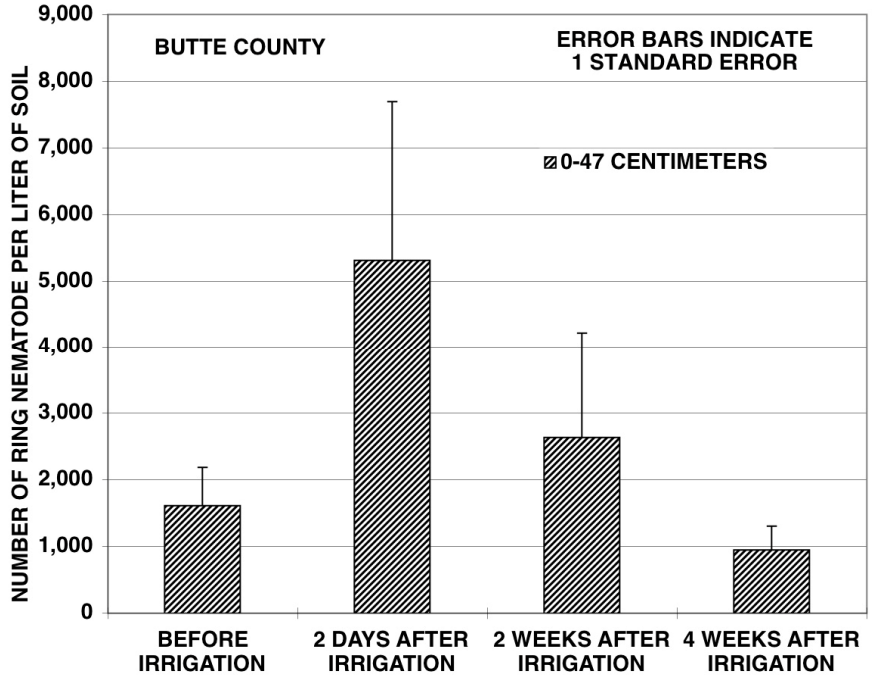

Fig. 6. Populations of ring nematode recovered before, and at three dates following irrigation in Butte County.

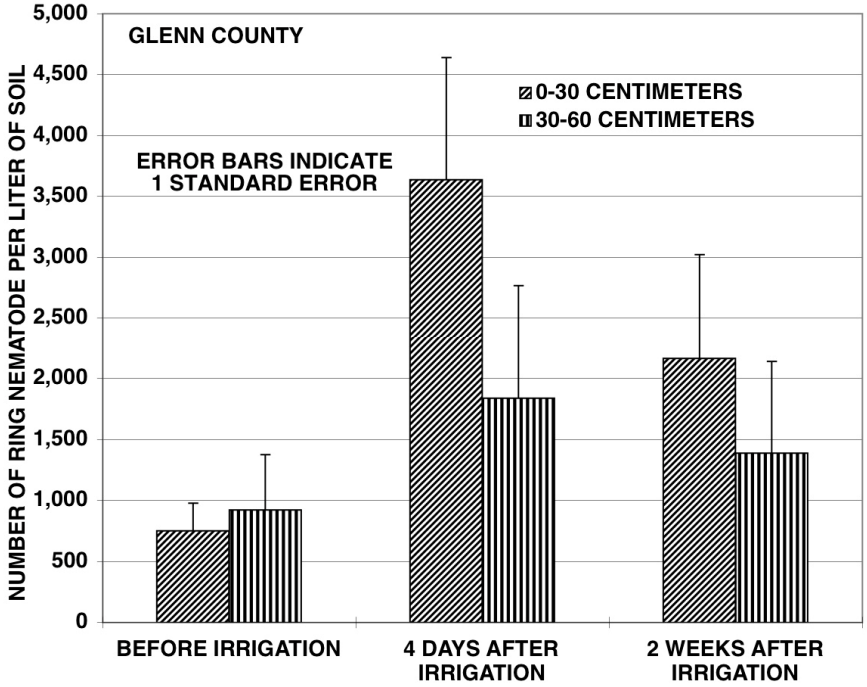

Fig. 7. Populations of ring nematode recovered before, and at two dates following irrigation in Glenn County.

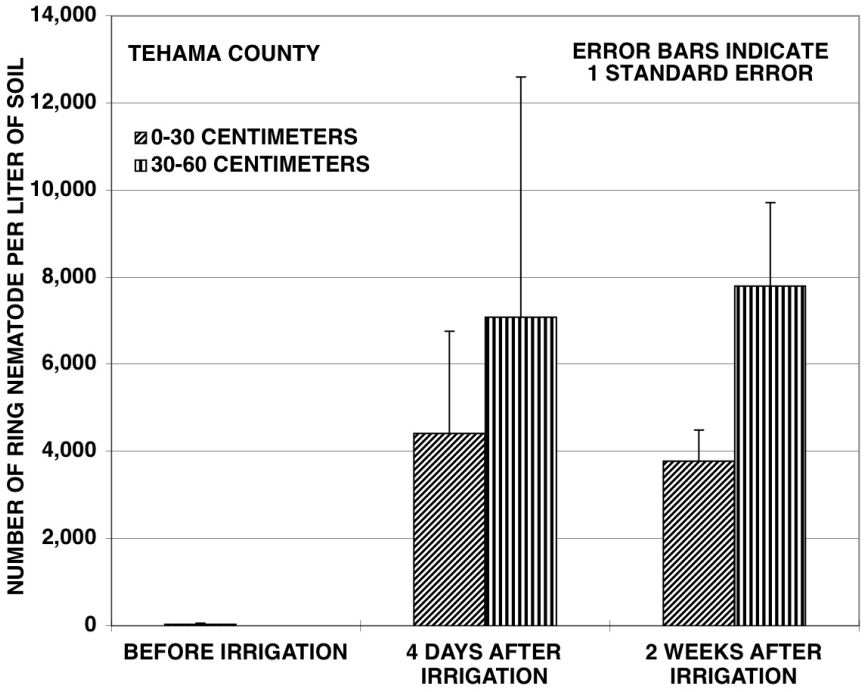

Fig. 8. Populations of ring nematode recovered before, and at two dates following irrigation in Tehama County.