FIFTY YEARS WITH A NEMATODE-FREE NURSERY PROGRAM

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The late 1950s were a time of considerable interest in plant parasitic nematodes relative to California agriculture. Researchers were providing proof of nematodes as virus vectors and indicating close associations with certain bacterial and fungal pathogens. An entire issue of *California Agriculture* was devoted to direct damage by various nematode species on a variety of crops. Nematode infected nursery plants were also becoming more common; the result being consumer malcontent and legal actions. Meanwhile, researchers were quick to state that the best control method for soil borne pests was sanitation. Since Department of Agriculture was already regulating food and plants as they entered the state by land, sea or air; perhaps the next step was automatic. Yes, Department of Food and Agriculture with offices in each county could require all plant shipments entering each county be certified as nematode-free. University researchers, nurserymen, the nematode control industry and regulatory agents of California Department of Agriculture formed a Nematode Study Committee to address this question. Could nematode diagnostics plus available technologies assure sale of nematode-free nursery stock being received by farmers? By 1959 a regulatory manual had been developed with focus on length of fallow periods, soil fumigant amounts plus associated handling and cultural practices. As innovations or fumigation restrictions have occurred the Nematode Study Committee has continued to update and improve cleanliness strategies as detailed in the Nursery Improvement Practices Manual (NIPM #7). This report is an attempt by one statewide researcher to summarize nematode sampling experiences that can provide clues about the overall value of county as well as statewide interceptions.

Nematode sampling data are available at the Kearney Ag Center near Parlier CA as compiled by Doug Johnson and this author. During a 45-year period either Elaine Otomo or Stephanie Kaku extracted nematodes in the following manner: The first methodology of extraction was a combination Cobb Sieve Mist extraction of soil. Washed, diced roots in any sample were also placed in the mist chamber when available. If Criconematidae were present in samples they were further extracted by centrifugation. If Longidoridae were present in samples they were extracted using the cheesecloth method of Cobb on a Baermann funnel. During the first 20 years of these collections approximately 2,500 samples were collected annually. The next 25 years approximately 5500 samples were collected per year. The number of samples from commercial agriculture over this time period approximated 1,500 soil or tissue samples per year with a focus toward pathogenic nematodes. For historical guidance a 1973 synopsis of nematodes present across the state was written by Siddiqui, Sher and French. Importantly, their samples include origin of the samples as being from cropland, nursery, urban, rangeland, forest or desert with less focus on their pathogenicity. Siddiqui et al. suggested the only native pathogenic nematode in the state is

Hemicycliophora arenaria. They speculated that all other pathogenic nematodes were imports. They further reported that finds of *Radopholus similis, Rotylenchulus reniformis* and *Xiphinema diversicaudatum* either have been or would be eradicated.

Our own sampling results indicate: 1) Nematodes on the increase include *Hemicycliophora arenaria* and *Criconemoides* spp. These pathogenic nematodes are associated with riparian habitats and have recently achieved high population levels among perennial crops specifically following the advent of low volume irrigation methods. 2) *Pratylenchus vulnus* is impacting 85% of walnut orchards though not always present in some very old, more isolated plantings. Walnut seeds are in nursery ground for 26 months while Prunus seeds are in nursery ground for 14 months. By contrast, only 35% of Prunus orchards show presence of *P. vulnus*. 3) *Xiphinema index* is increasing in Kern and Tulare Co table grapes where their nurseries do not ship outside their county. 4) *Tylenchulus semipenetrans* is increasing in vineyards located within 2 miles of citrus orchards but mostly absent from raisin vineyards which are located miles further. 5) *Tylenchulus semipenetrans* was common in oldest central valley locations (Orange Cove and Lemon Cove) and is now common all along the Sierra foothill plantings. 6) Populations of *Meloidogyne* spp on grape become aggressive in sands where rootstocks such as Harmony or Freedom (non durable resistance) were planted. 7) *Ditylenchus dipsaci* on garlic cloves in some manner become problematic every dozen years as seed is brought in from out of state sources. 8) *D. dipsaci* damage to alfalfa flares up in moist springs until alfalfa is not the crop. 9) *Belonolaimus* sp is now present on golf greens in Southern California deserts (Ploeg). 10) *Anguina pacifica* is damaging golf courses of the bay area (Westerdahl). 11) *Meloidogyne* nsp is damaging golf greens of Palm Springs (Becker, Ploeg). 12) *Meloidogyne chitwoodi* in older vineyards can show root knot in soil but no galling.

It is notable that soil sampling from commercial settings has not yet revealed *R. reniformis, R. similis* or Nacobbus spp. in California croplands but some of these species can be found within 30 miles south of the Mexican border. Results that indicate a possible weakness in NIPM are in need of follow-up including # 2) and #5). Results that can not be attributed to a weakness of NIPM regulations include: 1), 3), 4), 6), 8), 9), 10), 11) and 12). It is unclear if result #7 is attributable to NIPM regulations or state entry regulations.

Bullet Points

Appearance of new and damaging nematodes in cropland appears to be a less common event than finding them in less-regulated non farmland settings.