AES/CE MAR 84 Workgroup/Department:

University of California
Division of Agricultural Sciences

PROJECT PLAN/RESEARCH GRANT PROPOSAL

Project Year 2008 Anticipated Duration of Project: 2 years

Project Leader: Michael McKenry Location: UC Riverside Nematology

Cooperating Personnel:

ProjectTitle: Methyl Bromide Alternatives

Keywords: *P. vulnus*, *Meloidogyne* spp.

Commodity(s) walnut Relevant AES/CE Project No. 3188H

Problem and its Significance:

The primary goal of our many years of study with walnut has been the development of alternatives to methyl bromide. Given the regulatory constraints associated with Telone treatment of medium and fine-textured soils, the inadequate performance of metam sodium and Basamid in walnut soils and the likelihood of never having iodomethane; our second goal is to replace soil fumigants. The easiest answer is to not grow walnuts for five years; just switch to a non-woody crop like alfalfa. However the economic repercussions to growers who just switch away from their favored perennial crop will be substantial in a global economy. My research direction has been to better understand the replant problem, to identify rootstocks with broader soil pest resistance/tolerance and to identify tactics that destroy the old soil ecosystem. This approach should yield opportunities for growers to replant after one full year of waiting.

For the grape industry we have identified two rootstocks that are tolerant to the rejection component of the replant problem. One of those stocks (O39-16) has resistance to only a single nematode species and the other (10-17A) has resistance to at least six nematode species. Five years after replanting the yield off these two rootstocks is the same whether fumigated or not however, yields from seven other rootstocks was cut in half by lack of fumigation (McKenry, 2006 San Joaquin Valley Table Grape Seminar).

For the stone fruit and almond industries, primarily on Nemaguard rootstock, we have identified one rootstock (Hansen 536) that consistently tolerates the rejection component of the replant problem (www.uckac.edu/nematode) and we are searching for others. Hansen 536 has no Nemaguard parentage and carries nematode resistance similar to Nemaguard except that it is highly susceptible to ring nematode.

Grape, almond and walnut growers need at least two rootstocks each so they can alternate from one to the other in order to avoid the rejection component of the replant problem. These rootstocks need to be of different parentage. Each rootstock should have a soil pest and disease profile complimentary to the other. To reduce the land idling time down to one year for each of these industries we already have a tactic for quickly killing remnant roots, the food source of the prevailing soil ecosystem. Garlon applications will serve this purpose for the walnut industry but lately we have reasons to believe that new approaches using Roundup may accomplish this as well.

The California walnut industry is hugely impacted by *Pratylenchus vulnus*, the root lesion nematode. This nematode is severely damaging particularly to young developing root systems but more specifically to the newest 3 to 12 inches of each new root initial of the root system. Root-knot nematodes,

Meloidogyne spp., can be just as damaging to the same root target, but primarily in sandier soils south of Sacramento. There is also the rejection component of the replant problem, an absolute deterrent of root growth for the first full year but they can grow past this malady. With all this root restriction, it is *Phytophthora* root rot that usually finishes off the trees.

For almond and grape growers we have been testing a five-step program to protect against the rejection component. 1) diagnose the problem, 2) kill the remnant root system and idle the land 1 year 3) soil preparation as needed 4) use an alternate rootstock and 5) apply starter nutrients at time of planting. Unlike almond and grape commodities about 85% of walnut orchards across California are infested with *P. vulnus.* Also availability of diverse rootstock sources for walnut is limited and there are no walnut rootstocks having true resistance to this nematode. We have the paradox VX211 clone with useful hybrid vigor and a modicum of resistance that should translate to some field tolerance. But, we still need to get these trees started out right.

We need a broader source of walnut parentage to search for *P. vulnus* resistance. This source will likely be one that permits *P. vulnus* feeding and reproduction at the terminal several inches but not further back. We also need to determine if different walnut sources respond differently with or without fumigation in a replant site. Until nematode resistance is found walnut growers need broadcast fumigation. The rejection component can be solved with spot or strip fumigation. A rootstock with nematode resistance plus different walnut parentage is needed before there is field evaluation of a 5-step program for walnuts (planting without fumigation). This new/updated project proposal reflects our intention to focus even greater effort toward rootstock screening.

Objectives:

1) Maintain the Rio Oso trial for yield data, rates of nematode return and tree growth
2) Remove up to half the trees (6 reps) from the VX211 and AX1 trial at Kearney Ag Center and graft over to Chandler for yield data
3) Obtain for further nematode and field evaluations the clones of RX032 and UZ229 (Wes Hackett).
4) Continue nematode evaluations of various *Juglans* species from the USDA Davis Repository.
5) Compare all *Juglans* selections in adjacent replicated fumigated and non-fumigated sites in two walnut replant orchards, one following NCB the other Paradox.
6) Quantify the number of root tips/tree, their length, and the length of each root tip that will host *P. vulnus* and *Meloidogyne* spp.

Explore at our KAC trial site the value of Garlon + one year of chemical drenches and/or non-hosts as methods for reducing soil populations of *P. vulnus*, *Mesocriconema xenoplax* and *Meloidogyne* spp. down to various soil depths.

Plans and Procedures:

Objective 1. The Rio Oso site is now sixth leaf and involves approximately 8 acres with every other tree being either NX or DN paradox. These rows have been planted over soil that received either methyl bromide to the 6-foot depth, TeloneII at 50 gallons per acre stripped with delivery to the 4.5-foot depth or a broadcast application of Metam sodium delivered to the 4 foot depth.

Objective 2. Within 48 macroplots (1/100th acre each) at KAC we have 12 reps each of VX211 and AX1 in each without nematodes plus 36 reps with nematodes. In fall 2006 we cut the trunks within 1/3 of these macroplots and applied Garlon. The remaining 4 or 8 reps will be grafted to Chandler for purposes of yield collection. Nematode sampling of the soil and trunk measurements will continue twice yearly.

Objective 3. Selection RX032 is a *Juglans microcarpa* that we selected because it performed well in our earliest nematode screens. A second *J. microcarpa* was also saved but its vigor level after 7 years is half

that of RX032 so it is being terminated. UZ229 is of interest because it is now the largest of 3 saved UZ trees. These three trees were originally selected because three out of ten appeared to keep *P. vulnus* away from their roots, very similar to what was observed with the NX seedlings. Wood will be submitted to Wes Hackett again this year for further nematode evaluations. Approximately 13 UZ229 were received from Dr. Hackett last year and they are currently receiving evaluation against *P. vulnus* on a lathe house bench. RX032 is of interest for its host status against nematodes but also for its growth habit against the rejection component.

Objective 4. In winter 2005-06 we received small amounts of Juglans seed from Ed Stover of the Germplasm Repository. These were planted into nematode inoculated soil at KAC. The most vigorous trees today include *J. hindsii* and *J. californica.* In addition we planted varying numbers of *J. regia, J. microcarpa, J. major, J. ailantifolia, J. mandshirica, J. cathayensis* and *J. nigra.* The *J. nigra* trees did not survive and more *J. microcarpa* are needed. We also received from Tom Burchell own-rooted Serr trees and Serr grafted onto NCB. These trees were all inoculated with *P. vulnus* and *Meloidogyne* spp. on June 15, 2006 and thus-far the only trees that have been removed for examination are one each of Serr own- rooted and Serr on NCB. In 2007 and beyond the Serr trees will be completely removed by backhoe to examine all roots but the other trees will be kept alive and only a portion of their roots removed every six months for 2 years.

Objective 5. Any trees worthy of future evaluation plus all the trees received from the repository will be sized for uniformity and then planted into adjacent fumigated and non-fumigated sites within a walnut replant site for two years to determine size differences. We usually require 6 trees for each rep and reps are needed because the intensity of the rejection component varies across a field. It will be difficult to find the rejection component without the presence of *P. vulnus*. Each year we will compare visible differences in growth as well as trunk diameters to determine if trees grow similar whether fumigated or not. We refer to this measurement as tolerance to the rejection component.

Objective 6. By carefully removing entire first-year trees with a backhoe we are able to capture most of the root system. We dissect the root system into: 1) root initials, their number and length, 2) fibrous roots that support the tips <7mm in diameter and 3) roots larger than 7mm diameter. Walnut roots whether English, Black or the hybrid tend not to support more than 3 *P. vulnus*/gram of root. Our interest is in the number of initials, their size and the portion of the root that does not support high population levels. Plant data are tabulated and each column analyzed statistically. Nematode counts are collected from each of these root groupings and also analyzed for differences.

Objective 7. Milo and true sudan grass are non hosts of *P. vulnus* in field settings. Many other plants are as well but following a year of Milo, for example, it is not unusal to find very few P. *vulnus* in the surface 2 feet of soil. This is the reason we recommend soil samples to 3-feet deep when searching for *P. vulnus* if the orchard has been out for a while. Acrolein is a weed killer that is used in aquatic settings such as ditches, lakes, ponds. It is also a good nematicide when applied to the 5-foot depth at 250 ppm in 6 inches of water. Further, NCB grows very well in the years following such applications.
We quit studies on this product back in 1994 because at 250 ppm the aldehyde odor was unbearable and adjacent barley was damaged. When applied at 7to14 ppm to waterways, none of these odor problems arise. I want to apply acrolein as a drench while milo or sudan grass are present and absent to determine how deep we can deliver nematicidal activity. Additionally, we now know that the walnut hull extract called NatureCur is quite nematicidal. Unlike most biological derived products NatureCur follows a dosage response curve in that if you apply more you get more kill. We want to use it as a pre-plant treatment with and without sudan grass or milo. Each of these chemical products should receive registration with out much problem. These plants and products and perhaps others will receive evaluation in our old VX211 sites at KAC where we now have *P. vulnus* to five feet and the soil is perfect for drenching. If successful nematode control is achieved we will replant with a variety of walnut selections by spring 2008.

Treatments for each of these objectives will be replicated at least 4 times but our limitation will likely be the availability of adequate walnut selections. All nematode counts will be log-transformed and subjected to ANOVA.

BUDGET REQUEST **2008-09** Budget Year

Funding Source: Walnut Marketing Board

Salaries and Benefits			
Postdocs/RA's			
SRA's	$16,000		$16,000
Lab/Field Assistance			
Subtotal		Sub 2	$16,000
Employee benefits		Sub 6	$ 5,120
		TOTAL	$21,120
Supplies and Expenses		Sub 3	$ 500
Equipment		Sub 4	
Travel		Sub 5	$ 2,380
		TOTAL	$24,000

Department account number _____

_____ Date 11/19/07

Originator's Signature

COOPERATIVE EXTENSION

County Director _____ Date _____

Program Director_____ Date _____

AGRICULTURAL EXPERIMENT STATION

Department Chair_____ Date _____

LIAISON OFFICER

_____ Date _____

D2454-2(1/84)
(Rev. 9/96)