

**To:** California Pepper Commission

**RE:** Research Report for 2015

**PI:** Antoon Ploeg, Associate Nematology Specialist, Dept. Nematology, UCR, 1463 Boyce Hall, Riverside CA 02521. antoon.ploeg@ucr.edu. Tel (951) 827-3192.

**Collaborator:** Jose Aguiar, UCCE Farm Advisor, Riverside County, 81-077 Indio Blvd. Suite H, Indio, California 92201. Tel. (760) 342-2467.

**Project Title:** Establishing Root-Knot Nematode Trial Site for Future Projects.

**Statement of the problem and background.**

The Southern root-knot nematode (*Meloidogyne incognita*) has been reported to cause serious damage to peppers. The second-stage nematodes (J2) are worm-shaped, move through the soil, and enter the plant roots. In roots of a host crop, the second-stage juveniles nematodes develop into females, while the root system responds to infection with the formation of galls. The fully developed females can produce up to 400 eggs, that are contained in clusters in a gelatinous material and “glued” to the outside of the roots. From these eggs second-stage juveniles can emerge to repeat the cycle, or eggs can remain in the soil during fallow period to serve as inoculum for the next crop cycle. The duration of the nematode life cycle depends primarily on the species of root-knot nematode and on soil temperature. *Meloidogyne incognita*, the most important species infecting bell-pepper, can complete its’ life cycle in less than 4 weeks under an optimum soil temperature of 32C (90F), and become inactive when the soil temperature drops below 17C (62F). In most host crops, root-knot nematode infestation can easily be diagnosed because of obvious galling on the affected roots. Above-ground symptoms are however not specific, and can include chlorosis, wilting under sufficient soil moisture, stunting, and increased susceptibility of plants to fungal or bacterial root pathogens.

In the Coachella Valley of Southern California, approximately 5,000 acres are cropped with bell peppers, representing an estimated gross crop value of \$90,000,000. Root-knot nematodes are widespread throughout the Coachella Valley and growers report serious damage. To control nematodes, pepper growers in the Coachella Valley commonly apply fumigant nematicides such as metam-sodium (Vapam) or 1,3-dichloropropene (Telone) as a post-harvest and/or pre-plant soil treatment through the drip tubing.

There are a few studies describing the interactions between the nematodes and bell peppers, but they are primarily from Europe. Although there is a general consensus among Coachella Valley growers that root-knot nematodes can result in major crop damage if not controlled, research data on damage thresholds and tolerance limits under their growing conditions (e.g. pepper varieties grown, occurring nematode populations/species, soil types and temperature regimes) are not available.

The goal of this project was to establish a trial site at the UCR Coachella Valley Research Station for future root-knot nematode studies on bell pepper.

**Objective of this project:**

1. Establish a trial site at the UCR Coachella Valley Research Station (CVARS) for root-knot nematode studies on bell pepper.

**Trial site location, size, and set-up.**

A trial site at CVARS was made available to us for future field studies. The site is on light sandy loam soil and is 60 ft wide and 160 ft long (0.22 acres), and had been fallow for several years. In early February, 2015 the field was overhead sprinkler irrigated, and bedded to have twenty-four, 30-inch (center-center) beds. Drip tubing was installed in all beds (buried 3 inches). Soil samples were collected from 12 locations within the field and processed for nematodes. No root-knot nematodes were found in any of the samples.

On 2/17/15 tomato 'Red Cherry Large' were seeded over all beds, and. On 4/20/2015 root-knot nematode eggs (*M. incognita*) were extracted from nematode infested roots of infested tomato plants grown at the UCR greenhouse. The nematodes had been originally isolated from roots of bell-pepper grown in a commercial Coachella Valley field. A total of 226 million nematode eggs were obtained from the tomato root systems. The egg suspension was taken to the trial site and the field was inoculated with these eggs by injecting the egg suspension through the drip system over a one hour period. The number of eggs (226 million) inoculated corresponds to 58,800 eggs inoculated per linear ft of bed. During the inoculation period, 50 ml of suspension coming out of a drip emitter was collected in 6 locations, taken back to UCR and the number of eggs were counted. Egg counts in 50 mls ranged between 1,000-1,600 eggs.

Egg hatching from the suspension used as inoculum was checked at UCR, Over a 10 day period, 46% of eggs had hatched into second stage juveniles.

On 7/21/15 tomato plants were dug in 12 locations, and the severity of root galling was rated visually on a 0-10 scale. At the same time, 12 soil samples were collected, taken back to UCR for nematode analysis (see Figure 1, Figure 2). On average, 550 second stage juveniles were counted per 100 g soil (Table 1). Root-galling was obvious on all plants (Fig. 3) and on average severe (average 7.3 on 0-10 scale).

Table 1. Root-knot nematode galling and second stage juveniles on roots of tomato collected on 7/21/2015 at a trial site at CVARS.

Sample	galling on roots (scale 0-10)	RKN J2 per 100 g soil
1	7	275
2	3	300
3	8	675
4	8	200
5	8	450
6	7	200
7	7	250
8	5	200
9	9	725
10	9	2950
11	9	350
12	8	50
average	7.3	552

Tomato plants were left over the winter, and will be incorporated in February 2016. The field will be prepared in early March, and nematode susceptible snap bean will be grown over the entire site to further establish and even-out the nematodes.

**Conclusion:**

From nematode symptoms on tomato roots and nematode soil counts it appears we have successfully established a field site that is evenly infested with a root-knot nematode *M. incognita* population originally obtained from infested bell-pepper roots.

**Future Plans**

We (Ploeg, Becker, Aguiar) have submitted a proposal to C-DPR to study effects of root-knot nematode infestation on nematode development, root-symptoms and crop yield of susceptible and resistant bell-pepper cultivars and a following carrot crop. In addition, the efficacy of novel nematicides will be examined in this project. Experiments proposed would take place on this trial site at CVARS. We expect to hear on funding for this proposal in March, 2016.

Figure 1. Field layout, and tomato root galling and nematode levels on 7/21/15.

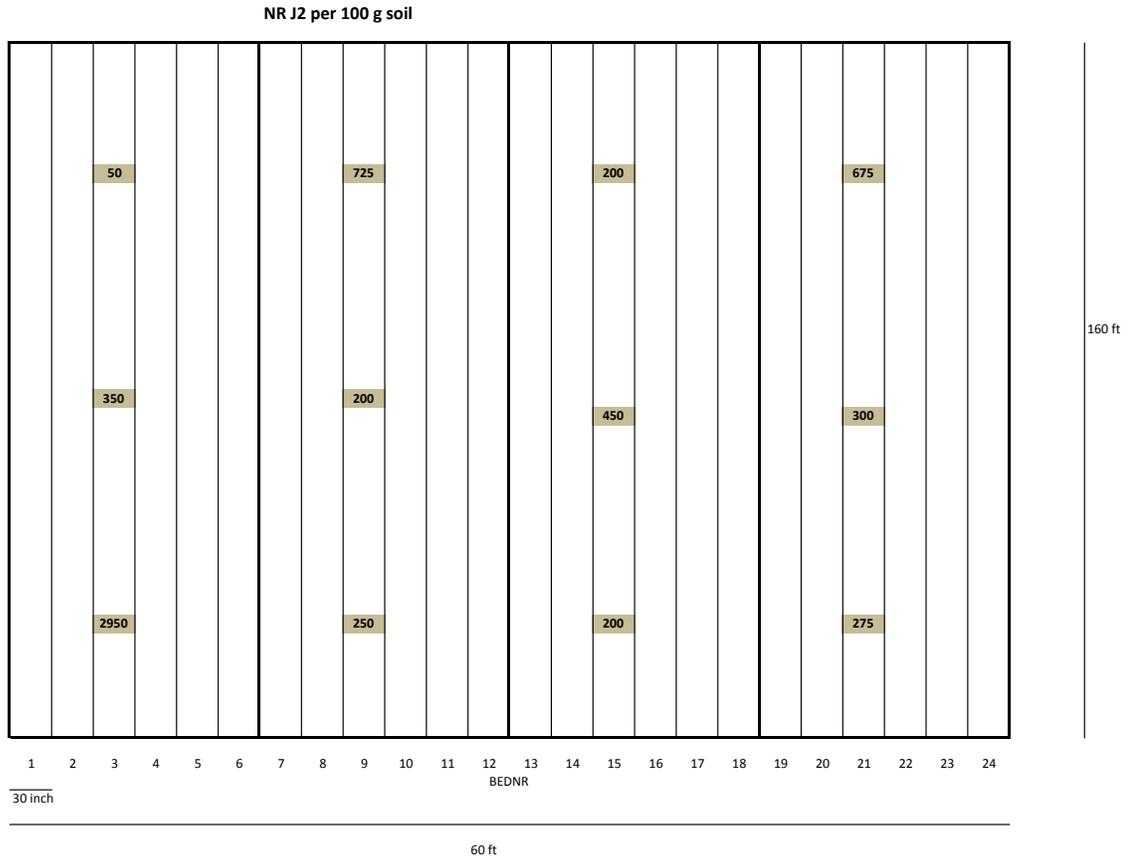
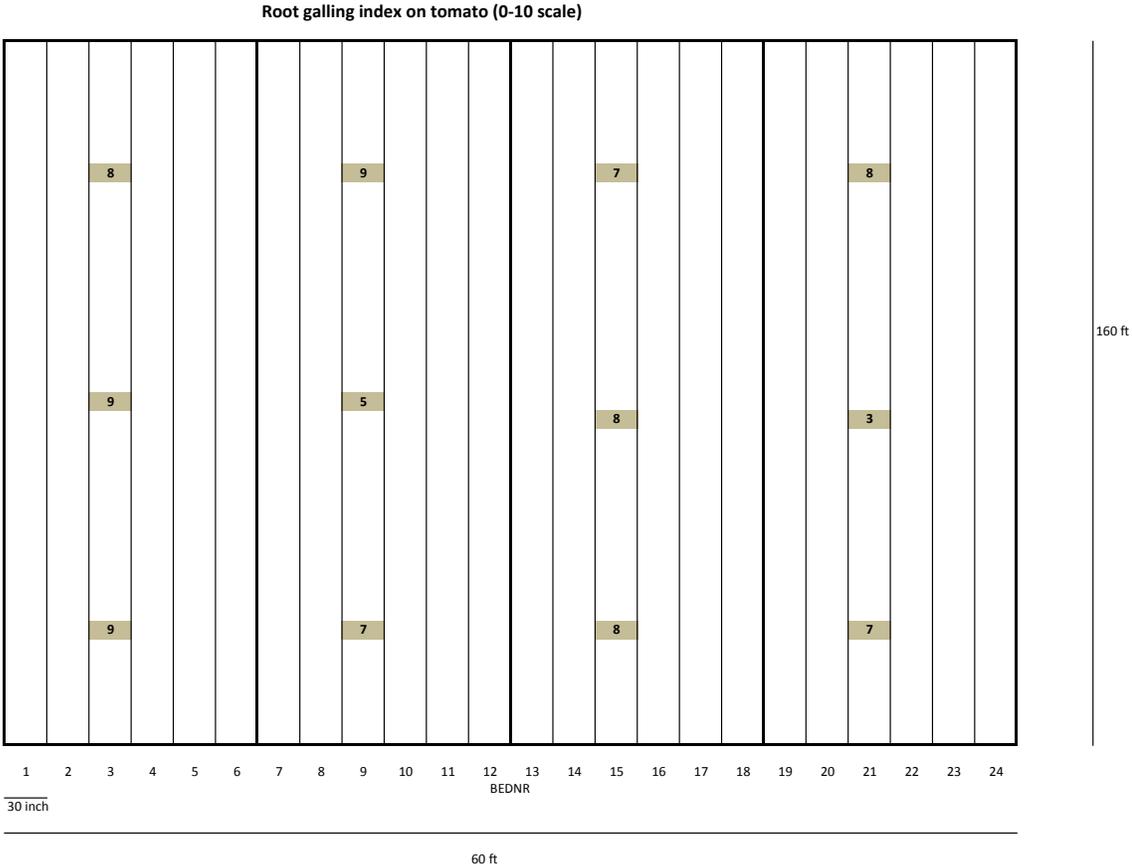


Figure 2. Field overview on 4/13/15.



Figure 3. Root-galling on tomato root (7/21/15)

