# PASSION FRUIT AND NARANJILLA AS HOSTS FOR SOYBEAN NEMATODES[1]

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ABSTRACT

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A greenhouse study was conducted to assess the susceptibility of yellow passion fruit (*Passiflora edulis* f. *flavicarpa*) and naranjilla (*Solanum quitoense*) to attack by soybean (*Glycine max*) nematodes. Six-week-old seedlings were transplanted into one-liter-capacity pots that contained a 50:50 (v:v) mixture of fine sand and a sandy loam soil from a soybean field. The soil was infested with cyst (*Heterodera glycines*), lesion (*Pratylenchus brachyurus*), stubby root (*Paratrichodorus christiei*), and root-knot (*Meloidogyne arenaria*) nematodes. There were also pots planted each with five 'Davis' soybean seeds. *H. glycines* developed only in pots with soybean. Roots of all plants were galled by *M. arenaria,* with soybean having the highest number of galls per root system. No *Meloidogyne* juveniles were recovered from passion fruit roots in contrast with naranjilla or soybean roots. Passion fruit roots were free of lesion nematodes but those of the other two plant species contained significant populations of the nematode. Stubby root nematodes were found only in soil planted to either naranjilla or soybean with larger populations in soil with the former plant species than in soil with the latter.

*Additional key words: host range, nematode management, ecology, plant breeding, crop rotations, carbamates, chemical control.*

RESUMEN

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Se efectuó un estudio de invernadero para determinar la susceptibilidad de la maracuyá (*Passiflora edulis* f. *flavicarpa*) y de la naranjilla (*Solanum quitoense*) al ataque por nematodos típicos de la soya (*Glycine max*). Se transplantaron plántulas de seis semanas de edad a macetas de un litro de volumen que contenian cada una un kilo de una mezcla al 50% por volumen de arena fina y un limo arenoso proveniente de un campo de soya. El limo estaba infestado con *Heterodera glycines, Pratylenchus brachyurus, Paratrichodorus christiei* y *Meloidogyne arenaria.* También hubieron macetas plantadas cada una con cinco semillas de soya 'Davis'. *H. glycines* se desarrolló sólo en macetas con soya. Las raíces de las tres especies de plantas mostraron nódulos causados por *M. arenaria.* No hubo producción de formas juveniles de *Meloidogyne* en las raíces de maracuyá lo que no fue asi en las de naranjilla o de soya. No hubo desarrollo de *P. brachyurus* en las raíces de maracuya pero si se observaron altas poblaciones de este nematodo en las raíces de naranjilla y en las de soya. *P. christiei* sólo se encontró en suelos con soya o con naranjilla siendo las poblaciones en suelo con la última planta más grandes que las en el de la soya.

*Palabras claves adicionales: gama de hospederos, manejo de nematodos, ecología, fitomejoramiento, rotación de cultivos, carbamatos, combate químico.*

## INTRODUCTION

In recent years in Alabama and other southeastern states of the United States, soybean acreage has declined in response to depressed prices and the lack of adequate world market demand. Soybean land has been turned over to other uses, such as forestry or pastures. There is the possibility that new crops may be introduced into some of these lands as substitutes for soybean. In fields close to urban areas it may be feasible to develop new markets for "exotic" tropical fruits and vegetables. Passion fruits (*Passiflora* spp.) and certain Andean *Solanum* spp. have the potential for development as fruit crops in latitudes and climates similar to those of the southern counties of Alabama (3,4). The introduction of plant species into new areas should be preceded by studies on the effects of the environment on them. Principal among these considerations are the effects of pest populations. This paper presents results of a study to determine the effect of nematodes typical of Alabama soybean fields on a species of *Passiflora* and a fruit-type *Solanum* crop.

## MATERIALS AND METHODS

A greenhouse study was conducted to determine the relative susceptibility of naranjilla (*Solanum quitoense* Lam.) and yellow passion fruit (*Passiflora edulis* f. *flavicarpa* Degener) to attack by nematodes associated typically with soybean (*Glycine max* [L.] Merr.) in Alabama. Soil used for the study was a sandy loam [pH = 6.2; org. matter <1.0% (w/w)] from a field near Elberta, Baldwin county, Alabama. The field had been in continuous soybean production with a winter cover crop of ryegrass (*Lolium* sp.) for at least ten years. The soil was infested with cyst (*Heterodera glycines* Ichinohe), lesion (*Pratylenchus brachyurus* [Godfrey] Goodey), stubby root (*Paratrichodorus christiei* [Allen] Siddiqi), and root-knot (*Meloidogyne arenaria* [Neal] Chitwood) nematodes. Races 3, 4, and an undescribed race of *H. glycines* were present in the field. Soil populations of cyst and root-knot nematodes were 15-20 juveniles/100 $cm^3$ soil, and the other species were each at <10 nematodes/100 $cm^3$ soil. The field soil was mixed 50:50 (v:v) with fine (<0.2 mm) river sand, which mixture will be referred henceforth in this paper as soil. The moist (60% field capacity) soil was apportioned in one kg amounts into 10-cm-diam one-liter-capacity cylindrical PVC pots.

Fifteen-cm-tall (6-wk-old) passion fruit or naranjilla seedlings were planted one to a pot. Passion fruit seed was obtained from Lima, Perú,

provided by Dr. Parviz Jatala, and naranjilla seed was from Medellín, Colombia, provided by Dr. Oscar Sohm. In the experiment there was also a series of pots planted each with 5 seeds of 'Davis' soybean each to serve as positive controls. This soybean cultivar is susceptible to all major races of *H. glycines* and has no tolerance (or resistance) to *M. arenaria*. Each plant species was represented by 16 replications (pots); soil in eight pots was left untreated and that in the other 8 replications was treated with aldicarb (Temik® 15G) at a rate of 9 mg a.i./kg soil. The treatment was effected by mixing, in a 3-liter polyethylene bag, one kg soil with the nematicide granules prior to delivery of the soil into the pots. Plants were maintained in a greenhouse in good growing condition for eight weeks, when they were removed from the soil. Each root system was examined to determine the number of galls caused by *M. arenaria* and a root-knot index value was assigned. The root-knot index scale used was that described by Zeck (8) where a value of one represents no galls and maximal galling is represented by a value of 10. The root system from each plant was also incubated in water for 72 hr as described elsewhere to recover nematodes (5). A 100-$cm^3$ soil sample from each pot was also used to determine nematode populations using the "salad bowl" incubation method (5). Data were collected from each plant for shoot height, and fresh weights of shoots and roots.

All data were analyzed following standard procedures for analysis of variance (7). Fisher's least significant differences were calculated (7) and are in the tables of results together with corresponding values for standard errors of the mean. Unless otherwise stated, all differences between means referred to in the text were significant at the 5% or lower level of probability.

## RESULTS AND DISCUSSION

Treatment with aldicarb had no effect on shoot height and the weights of fresh shoots or roots of passion fruit (Table 1). The treatment resulted in soybean and naranjilla plants with taller shoots and heavier shoots and roots than the untreated plants.

The lowest number of galls caused by *M. arenaria* and the lowest root-knot index values corresponded to passion fruit roots (Table 2); roots of this plant also had the lowest numbers of all phytonematode species. The cyst nematode developed only in pots with soybeans and no juveniles of this nematode were recovered from roots of either naranjilla or passion fruit. Soybean and naranjilla roots were equally good hosts for the lesion nematode but fewer numbers of *M. arenaria* juveniles were found in naranjilla roots than in soybean roots. Aldicarb treatments reduced populations of all nematodes in roots of soybean or naranjilla. This may explain partly the increased plant growth responses

Table 1. Effect of aldicarb on development of naranjilla (*Solanum quitoense*), yellow passion fruit (*Passiflora edulis* f. *flavicarpa*) and 'Davis' soybean in soil infested with soybean nematodes.

| | Shoot height (cm) | | Fresh shoot weight (g) | | Fresh root weight (g) | |
|---|---|---|---|---|---|---|
| | Untreated | Aldicarb[y] | Untreated | Aldicarb | Untreated | Aldicarb |
| Soybean | 23.6 | 32.4 | 12.2 | 14.9 | 12.0 | 12.5 |
| Passion Fruit | 25.1 | 23.4 | 18.4 | 17.3 | 11.3 | 10.1 |
| Naranjilla | 22.0 | 23.2 | 20.7 | 23.3 | 8.4 | 13.5 |

[y]Aldicarb (Temik® 15G) applied at 9 mg a.i./kg soil.
[z]For each variable, differences for soybean and naranjilla between nematicide treatments were significant (P = 0.05) but were not significant for passion fruit.

to the nematicide treatment observed for these two plants (Table 1). Passion fruit roots had very low numbers of nematodes and the aldicarb treatment did not result in any positive plant growth response.

Soil nematode populations were again lowest for passion fruit and this was true for both non-parasitic and phytonematode species Table 3). Cyst nematode juveniles were found only in soils with soybean. Soil juvenile populations of *M. arenaria* were very low (<10/100 $cm^3$ soil) in all soils so that the data were not useful for comparisons and are consequently omitted from Table 3. Naranjilla was a good host for the stubby root nematode; it supported higher populations of this nematode than did soybean. Aldicarb reduced populations of stubby root nematode in soil but had the opposite effect on the numbers of juveniles of *H. glycines* in soil.

Results from this study indicate that yellow passion fruit may be a good species to use in nematode infested soybean fields. It is not a host for *M. arenaria.* This agrees well with the findings of Kirby in the Fiji islands (1), who found that *P. edulis* f. *flavicarpa* was not a good host for *M. arenaria, M. incognita,* or *M. javanica.* Kirby observed that these nematodes caused galls in the roots but that there were no eggs or viable females in the galls as there were in galls of tomato roots. In his study, Kirby also found that the reniform nematode, *Rotylenchulus reniformis* Linford and Oliveira, reproduced well on passion fruit roots.

Our results indicate that, in contrast with passion fruit, introduction of naranjilla in soybean fields is likely to result in problems caused by root-knot, lesion, or stubby root nematodes.

Passion fruit seedlings can be planted as an annual crop in southern Alabama counties where the species fruits but may not survive through most winters. Yellow passion fruit is closely allied to *P. incarnata* L., the "may pop" weed, common and indigenous of the southeastern United States (3,4). The two species are in the series Incarnatae of the genus and have the same chromosome number (2n = 18 (6). It should be pos-

Table 2. Effect of aldicarb on nematode populations in roots of 'Davis' soybean, naranjilla (*Solanum quitoense*), and yellow passion fruit (*Passiflora edulis* f. *flavicarpa*).

| | Galls/root system[y] | | Root-knot index[x] | | *M. arenaria* juveniles[y] | | *H. glycines* juveniles[y] | | *P. brachyurus*[y] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Untreated | Aldicarb[w] | Untreated | Aldicarb | Untreated | Aldicarb | Untreated | Aldicarb | Untreated | Aldicarb |
| Soybean | 57 | 24 | 4.9 | 2.5 | 117 | 23 | 129 | 54 | 42 | 4 |
| Passion Fruit | 7 | 7 | 1.4 | 2.0 | 3 | 0 | 0 | 0 | 0 | 0 |
| Naranjilla | 19 | 7 | 3.4 | 1.7 | 62 | 12 | 0 | 0 | 40 | 14 |
| LSD (P = 0.05)[z] | 8 | 8 | 0.7 | 0.7 | 26 | 26 | 13 | 13 | 11 | 11 |
| $S\bar{x}$ | 2.9 | 2.9 | 0.2 | 0.2 | 9.2 | 9.2 | 4.5 | 4.5 | 3.7 | 3.7 |

[w]Aldicarb (Temik® 15G) applied at 9 mg a.i./kg soil.
[x]Scale: 1 = no galls to 10 = maximal galling.
[y]Number per root system.
[z]LSD values for comparisons between plant species and between nematicide treatments. $S\bar{x}$ = standard error of the mean.

Table 3. Effect of aldicarb on populations of soybean nematodes and nonparasitic species in soil planted to naranjilla (*Solanum quitoense*), yellow passion fruit (*Passiflora edulis* f. *flavicarpa*), and 'Davis' soybean.

| | *H. glycines* juveniles[y] | | *P. christiei*[y] | | Nonparasitic nematodes[y] | |
|---|---|---|---|---|---|---|
| | Untreated | Aldicarb[x] | Untreated | Aldicarb | Untreated | Aldicarb |
| Soybean | 60 | 129 | 131 | 1 | 217 | 217 |
| Passion Fruit | 0 | 0 | 0 | 0 | 38 | 66 |
| Naranjilla | 1 | 8 | 290 | 161 | 97 | 178 |
| LSD (P = 0.05)[z] | 28 | 28 | 37 | 37 | 49 | 49 |
| $S\bar{x}$ | 9.6 | 9.6 | 13 | 13 | 17 | 17 |

[x]Aldicarb (Temik® 15G) applied at 9 mg a.i./kg soil.
[y]Number per 100 $cm^3$ soil.
[z]LSD values for comparisons between plant species and between nematicide treatments.
$S\bar{x}$ = standard error of the mean.

sible to effect crosses between these species (3) with a view to extend the northward range of cultivation of edible passion fruits with hybrids free of nematode problems. Indeed, recently Knight (2) has succeeded in developing passion fruit hybrids for the temperate zone. The low susceptibility of yellow passion fruit to root-knot nematodes suggests that this species may have active principles that do not permit development of some nematode species in its roots.

## LITERATURE CITED

1. KIRBY, M. F. 1978. Reniform and root-knot nematodes on passion fruit in Fiji. Nematropica 8:21-25.
2. KNIGHT, R. J., JR. 1986. Alloploid passion fruit hybrids for the temperate zone. HortScience 21:695 (Abstr.).
3. MARTIN, F. W., and H. Y. NAKASONE. 1970. The edible species of *Passiflora*. Economic Botany :333-343.
4. PURSEGLOVE, J. W. 1968. Tropical Crops. Dicotyledons. Longman, London. 719 pp.
5. RODRIGUEZ-KABANA, R., and M. H. POPE. 1981. A simple incubation method for the extraction of nematodes from soil. Nematropica 11:175-186.
6. STOREY, W. B. 1950. Chromosome numbers of some species of *Passiflora* occurring in Hawaii. Pacific Science 4:37-42.
7. STEEL, R. G. D., and J. H. TORRIE. 1960. Principles and procedures of statistics. McGraw-Hill Book Co., Inc., New York. 481 pp.

8. ZECK, W. M. 1971. A rating scheme for field evaluation of root-knot nematode infestations. Pflanzenschutz Nach. 24:141-144.

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