RESEARCH NOTE/NOTA INVESTIGATIVA

DIFFERENCES AMONG RED-SKINNED POTATO CULTIVARS AND THEIR RESPONSE TO *MELOIDOGYNE* SPECIES

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ABSTRACT

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The reproduction and damage caused by *Meloidogyne incognita*, *M. javanica*, and *M. konaensis* were compared on the red-skinned potato cultivars Desiree, Mountain Rose, Pink Pearl, and Red Thumb. Desiree was susceptible to the root-knot nematodes evaluated and exhibited tolerance to the nematodes as well. Mountain Rose was resistant and tolerant to *M. incognita* and *M. konaensis* but susceptible and intolerant to *M. javanica*. Pink Pearl was susceptible to all three nematode species and was tolerant to *M. javanica* and *M. konaensis* but not to *M. incognita*. Red Thumb was susceptible to *M. incognita* but resistant to *M. javanica* and *M. konaensis*. Red Thumb was intolerant to all three root-knot nematode species. Penetration and nematode development were evaluated in another experiment. Fewer *M. incognita* penetrated Mountain Rose than *M. javanica* (7% vs. 39% of inoculated J2). The few *M. incognita* that penetrated Mountain Rose developed slowly, and males were observed in Mountain Rose tubers that were infected with *M. incognita*. On Red Thumb, penetration by *M. incognita* was higher (38%) than *M. javanica* (13%), and *M. incognita* developed faster reaching a fourth-stage juvenile in 12 days. A unique relationship and specific interaction between Mountain Rose and *M. incognita* and between Red Thumb and *M. javanica* was found. Further understanding of this specific resistance might be useful and practical in breeding potato resistant to multiple species of *Meloidogyne*.

Key words: Meloidogyne incognita, *Meloidogyne javanica*, *Meloidogyne konaensis*, *Solanum tuberosum*.

RESUMEN

Kandouh, B. and B. Sipes. 2014. Diferencias en la resistencia de patata de piel roja a especies de *Meloidogyne*. Nematropica 44:47-50.

La reproducción y el daño causado por *Meloidogyne incognita*, *M. javanica* y *M. konaensis* se compararon en los cultivares de piel roja Desiree, Mountain Rose, Pink Pearl, y Red Thumb. Desiree era susceptible y exhibió tolerancia a los nematodos evaluados. Mountain Rose era resistente y tolerante a *M. incognita* y *M. konaensis* pero susceptible e intolerante a *M. javanica*. Pink Pearl era susceptible a las tres especies de nematodos y era tolerante a *M. javanica* y *M. konaensis* pero no a *M. incognita*. Red Thumb era susceptible a *M. incognita* pero resistente a *M. javanica* y *M. konaensis*. Red Thumb era intolerante a las tres especies de nematodos de los nudos radicales. La penetración y el desarrollo de los nematodos se evaluaron en otro experimento. *M. incognita* penetró en menor proporción que *M. javanica* en Mountain Rose (7% frente al 39% de los inoculados J2). Los pocos *M. incognita* que penetraron en Mountain Rose se desarrollaron lentamente y se observaron machos en los tubérculos de Mountain Rose infectados con *M. incognita*. En Red Thumb, la penetración por *M. incognita* fue mayor (38%) que la de *M. javanica* (13%) y *M. incognita* se desarrolló más rápido llegando a el juvenil de cuarta-etapa en 12 días. Se encontró una relación única e interacción específica entre Mountain Rose y *M. incognita* y entre Red Thumb y *M. javanica*. Profundizar en la comprensión de esta resistencia específica podría ser útil y práctico en la cría de patata resistentes a múltiples especies de *Meloidogyne*.

Palabras clave: Meloidogyne incognita, *Meloidogyne javanica*, *Meloidogyne konaensis*, *Solanum tuberosum*.

Resistance to one *Meloidogyne* sp. often confers resistance to other root-knot nematode species (Sasser, 1980). The *Mi*$_{-1}$ gene in *Solanum lycopersicum* confers resistance to *M. arenaria*, *M. incognita*, and *M. javanica* (Dropkin, 1969). In *Capsicum annuum*, resistance to *M. incognita* also provides resistance to *M. javanica* and *M. hapla* (Thies and Fery, 2000). *Solanum tuberosum* and related species with resistance to *M. chitwoodi* have resistance also to *M. fallax* (Janssen *et al*., 1996; Janssen *et al*., 1997; Van der Beek *et al*., 1998). Similarly, several breeding clones of *Solanum tuberosum* with resistance to *M. incognita* had the same response to *M. javanica* (Greco *et al*., 2007). An increase in the local production of red-skinned potatoes (*S. tuberosum*) led us to compare the susceptibility of selected cultivars to *M. incognita*, *M. javanica*, and *M. konaensis*, which are common root-knot nematode species in Hawaii, and to determine difference in penetration between *M. incognita* and *M. javanica* on susceptible red-skinned potato cultivars.

Meloidogyne incognita and *M. javanica* cultures were maintained on *S. lycopersicon* cv. Pixie, and *M. konaensis* was maintained on *Coffea arabica*. Egg inocula were collected by gently washing roots free of soil. Tomato roots were cut into 1-cm long pieces and shaken in 0.5% NaOCl for 4 min. Coffee roots were chopped, blended in a food processor with 0.5% NaOCl for 10 s, and then shaken for 4 min using a wrist-action shaker (Hussey and Barker, 1973). Eggs were collected on a 20-µm pore sieve (McSorley and Parrado, 1981), counted, and adjusted to 1,000 eggs/ml. Second-stage juveniles (J2) were collected by placing eggs in hatching chambers and retrieving the vermiform stages 48 hr later.

One-week-old red-skinned potato plants, started from seed pieces of cultivars Desiree, Mountain Rose, Pink Pearl, and Red Thumb (Potato Garden, Austin, CO), were inoculated with 10,000 eggs of *M. incognita*, *M. javanica*, *M. konaensis*, or left uninoculated. Treatments were arranged in a randomized complete block design with four replications. The entire experiment was repeated once. Potatoes were planted individually in 6-L paper-pulp pots filled with 2:1 sterile sand/soil for the first run or 1:1:1 sterile sand, soil, and Big R, a redwood soil conditioner (Kellogg Garden Products, Carson, CA), for the second run. Plants were maintained on benches in a shade house and were hilled with 2 to 3 cm^3 of media three times during the growing period.

Potatoes were harvested when the plants senesced. Tuber weight was recorded, and tubers were chopped into 1-cm^3 pieces, blended in a food processor with 50 ml 0.5% NaOCl for 10 s, placed in 500 ml flasks, and shaken for 4 min in a wrist-action shaker (Hussey and Barker, 1973). Eggs were collected on a 20-µm pore sieve (McSorley and Parrado, 1981). Nematode eggs were counted under a dissecting microscope to give the final nematode population density (Pf). A Reproductive factor (Rf = Pf/Pi) was calculated for each cultivar-

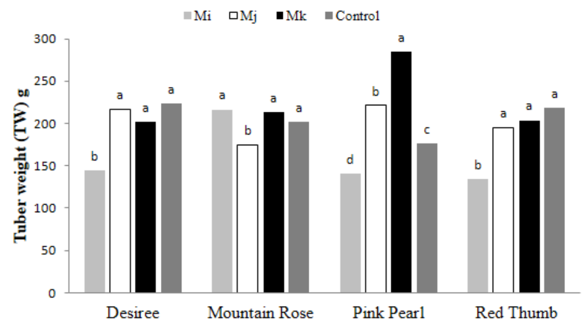

Fig. 1. The effect of three root-knot nematode species on potato tuber weight (TW) of four red- skinned potato cultivars (Mi = *Meloidogyne incognita*, Mj = *M. javanica*, and Mk = *M. konaensis*, Control = no nematode). Within a cultivar, bars with different letters are different ($P \leq 0.05$).

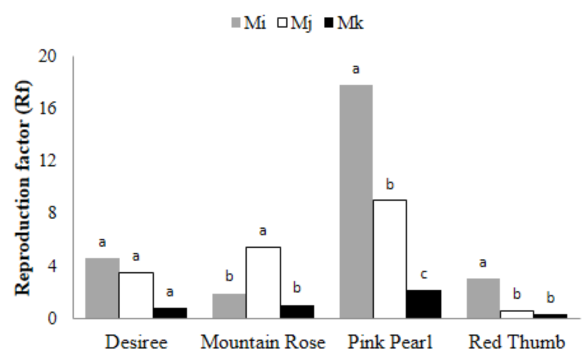

Fig. 2. Differences in the Reproduction factor (Rf) of *M. incognita* (Mi), *M. javanica* (Mj) or *M. konaensis* (Mk) among red-skinned potato cultivars. Within a cultivar, bars with different letters are different ($P \leq 0.05$).

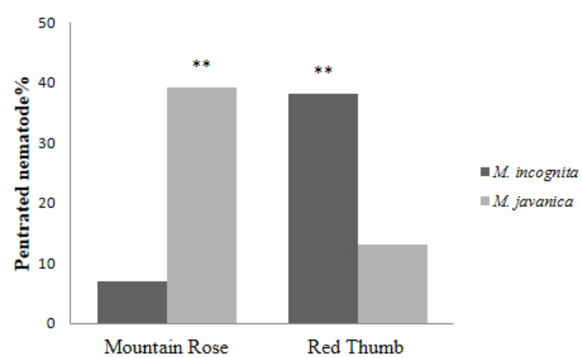

Fig. 3. Penetration of *M. incognita* and *M. javanica* on Mountain Rose and Red Thumb red-skinned potato 12 d after inoculation. ** indicates difference ($P \leq 0.05$) between means for each cultivar.

nematode combination. Tuber weight and nematode Rf were compared among cultivars and nematode species. Duncan's multiple range test (P<0.05) was used for mean separation.

Penetration and nematode development were compared between Mountain Rose and Red Thumb since these cultivars represented different responses to *M incognita* and *M. javanica*. Four seed tubers were individually planted in 2-L clay pots filled with 1:1:1 sand, soil, and Big R. Pots were maintained in a shade house and inoculated with 1,000 freshly hatched J2 of *M. incognita* or *M. javanica* 10 d after planting. Twelve days post inoculation (DPI), roots were gently washed free of soil and stained (Daykin and Hussey, 1985). Destained roots were divided into 3 to 4 portions, placed in inverted Petri dishes, and nematodes that had penetrated were counted under the dissecting microscope. Developmental stages of the nematodes inside the roots were also observed and compared between nematode species across the cultivars (Abad *et al*., 2010). Nematode numbers were recorded and differences between cultivars and *Meloidogyne* spp. compared.

Tuber weight differed among cultivars across root-knot species (Fig. 1). Tuber weight of Desiree, Pink Pearl, and Red Thumb was reduced by *M. incognita* but not the other nematodes. Tuber weight of Mountain Rose was reduced by *M. javanica*. Pink Pearl tuber weight was increased by *M. javanica* and *M. konaensis*.

Reproduction differed among cultivars and nematode species (Fig. 2). Pink Pearl had the highest Rf among all four cultivars across nematode species. Rf within Desiree showed no differences among root-knot nematode species. For Mountain Rose, the Rf of *M. javanica* was higher (P≤0.05) than that of *M. incognita* or *M. konaensis* and did not differ between *M. incognita* and *M. konaensis*. The Rf of *M. javanica* was higher (P≤0.05) than that of *M. konaensis* and lower than *M. incognita* in Pink Pearl. On Red Thumb, the Rf of *M. incognita* was higher than that of *M. javanica* or *M. konaensis* (P≤0.05), while reproduction on the last two was similar.

Meloidogyne incognita and *M. javanica* penetration and development differed between the cultivars (Fig. 3). Penetration by *M. incognita* on Mountain Rose was lower than penetration by *M. javanica* (7% and 39% of inoculated J2, respectively, P<0.05). The few *M. incognita* that penetrated into the roots of Mountain Rose developed slowly. Most of the *M. incognita* J2 remained vermiform 12 DPI, and no multiple infections were detected in a gall. Males were only observed in tubers of Mountain Rose infected with *M. incognita*. *Meloidogyne javanica* J2 developed faster and had reached the swollen J2 stage on the Mountain Rose within 12 DPI. Galls were larger and frequently contained multiple nematodes on Mountain Rose with *M. javanica*. On Red Thumb, penetration by *M. incognita* was higher (38%) compared to *M. javanica* (13%; P<0.05). *Meloidogyne incognita* developed faster on Red Thumb with most infecting J2 reaching the fourth-stage within 12 DPI. No difference in root swelling on Red Thumb was evident between the nematode species. Multiple infections in Red Thumb were more frequently detected in plants inoculated with *M. incognita* than with *M. javanica*.

Red Thumb was susceptible to *M. incognita* and resistant to *M. javanica* and *M. konaensis* and intolerant to all three root-knot nematode species. Desiree was susceptible to the root-knot nematodes evaluated and exhibited tolerance to the nematodes as well. Mountain Rose was resistant and tolerant to *M. incognita* and *M. konaensis* but susceptible and intolerant to *M. javanica*. Pink Pearl was susceptible to all three nematode species but had different levels of tolerance to the nematodes, being tolerant to both *M. javanica* and *M. konaensis* but intolerant to *M. incognita*. A unique relationship and specific interaction between Mountain Rose and *M. incognita* and between Red Thumb and *M. javanica* was found. Genetically specific interactions seem to be at play. Further understanding of this specific resistance might be useful and practical in breeding potato resistant to multiple species of *Meloidogyne*.

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