[Research Note]

Host suitability of a common oat cultivar Sniper for five plant-parasitic nematode species

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A newly bred, common oat cultivar Sniper, which has originated from Tachiibuki, a known fall forage cultivar that suppresses root-knot nematodes damage to succeeding crop of sweet potatoes, was tested to examine its susceptibility to five major nematode species which were distributed in upland of Kyushu, Japan. Sniper showed poor host suitability to the four *Meloidogyne* species in a pot experiment. Meanwhile, its host suitability for *Pratylenchus coffeae* was similar to that exhibited by other common oat cultivars examined in this study. Nematol. Res. 46(1), 21–24 (2016).

Key words: *Avena sativa*, *Meloidogyne* spp., *Pratylenchus coffeae*.

INTRODUCTION

Common oat (*Avena sativa*) is a major crop for forage and green manure in Japan. Particularly in Kyushu, the southwestern warm climatic region of Japan, fall cropping of an early common oat cultivar is important for the feed supply in early winters (Katsura, 2004). Previous reports have found poor reproduction of *Meloidogyne incognita*, a major nematode pest of many upland crops in Kyushu, on the Tachiibuki cultivar of common oat (Tateishi *et al*., 2008, 2011) and a significant reduction in nematode damage on sweet potatoes (*Ipomoea batatas*) succeeding the fall cropping of Tachiibuki in a field plot study (Tateishi *et al*., 2008). Fall cropping of Tachiibuki could be combined with forcing sweet potato cropping in the annual cropping system with little overlapping of the cropping seasons. Such a cropping system could provide a solution for sustainable nematode control and collaboration between crop farming and livestock industry. However, Tachiibuki cannot be successfully used as a fall forage crop in some cases, that is, it does not reach the heading stage and the yield is low when seeded in late September (Katsura and Tateishi, 2013).

Sniper is a newly bred common oat cultivar originated from the progeny of a cross between cultivars, Tachiibuki and Super-hayate-hayabusa. A breeding program for this cultivar was conducted to confer certain heading habits in the late sowing stage and host unsuitability for *M. incognita* reproduction. Consequently, Sniper got earlier heading and more yield than Tachiibuki for seeding in the second half of September (Katsura and Tateishi, 2013). Furthermore, fall cropping of Sniper suppressed an increase in the the nematode density in a field infested with *M. incognita* and *M. arenaria* as well as that of Tachiibuki (Katsura and Tateishi, 2013). To apply Sniper as a rotational crop in an extended area with different cropping conditions, it is essential to investigate whether or not other plant-parasitic nematodes can reproduce on this cultivar. In the present study, we tested the host suitability of Sniper for five major nematode species, which were distributed in the uplands of Kyushu (Iwahori, 2010), under greenhouse conditions.

MATERIALS AND METHODS

Tested seeds of Sniper were obtained from a collaborative project after-mentioned, and other common oat cultivars Tachiibuki and Haeibuki were obtained from the Laboratory of Forage Crop Breeding at the NARO/KARC. Commercially available seeds of the test cultivar of black oat (*A. strigosa*) Hay-oats were purchased from Snow Brand Seed Co., Ltd., Japan. Commercially available seeds of a tomato (*Solanum lycopersicum*) cultivar Pritz, used as a control host of all the tested nematode species, were purchased from Kaneko Seeds Co., Ltd., Japan.

The host suitability test for the root-knot nematodes was performed as described by Tateishi *et al.* (2011). We tested three isolates of *M. incognita* (Nishigoshi, Miyakonojo, and Tsukuba), two isolates of *M. arenaria* (Kikuyo and Kochi-1), and one isolate of *M. hapla* (Koshi), all of which were used in Tateishi *et al.* (2011). Moreover, a Kasari isolate of *M. javanica* collected at Amami City in Kagoshima Prefecture was also tested. All the isolates were originated from a single egg mass. Seedlings of the test plants were transplanted to a polyethylene pot (6 cm in diameter) filled with 100 ml

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steam-sterilized Melanudands consisting of 15.8% sand, 24.9% silt, and 59.3% clay. These plants were inoculated with approximately 500 second-stage juveniles (J2) of nematodes hatched from egg masses, and cultured for 63 days under greenhouse conditions (at an average soil temperature of 21.7℃). The number of nematode egg masses produced on each root system was counted by phloxine B staining method (Tateishi *et al.*, 2011). Additionally, up to 10 intact egg masses were randomly chosen from the root systems. Then, the number of eggs and eggshells embedded in the selected egg masses were dissolved in sodium hypochlorite solution and counted (Tateishi *et al.*, 2011).

Host suitability test for *Pratylenchus coffeae* was conducted as described below. The KM4 isolate of *P. coffeae* (RFLP phenotype A) that originated from a single female nematode collected at Miyakonojo City in Miyazaki Prefecture (Mizukubo *et al.*, 2003) was tested. A tomato seedling was transplanted to a pot filled with steam-sterilized Melanudands, and was then inoculated with some nematode-infested lucerne (*Medicago sativa*) calluses. After cultivation in a greenhouse for a few months, soil was recovered from the pot, stirred well, and used as inocula. Each oat seedling prepared in the above-described manner was transplanted to a polyethylene pot filled with 100 ml steam-sterilized Melanudands and 22.6 g inoculum. Because the average number of mixed stages of *P. coffeae* extracted from 20 g of inoculum by using the Baermann funnel technique was estimated to be 616.7, the initial nematode number per pot corresponded to approximately 700. After 65 days of cultivation under greenhouse conditions (at an average soil temperature of 21.5℃), the root clump was separated into root and soil. Nematodes were extracted from chopped whole roots from each pot by using the Baermann funnel technique at around 20℃ for 6 days and from one 20 g soil sample per pot in the same manner for 3 days. The number of *P. coffeae* individuals in the soil contained per pot was calculated using the number extracted from the soil sample and the weight of the soil contained in each pot.

Statistical analyses were performed using Ekuseru-Toukei 2015 (Social Survey Research Information Co., Ltd., Japan).

RESULTS AND DISCUSSION

According to the thermal properties of the nematode isolates tested for their development (Iwahori *et al.*, 2010; Mizukubo, 1997) and soil temperature in the pot monitored at hourly intervals during cultivation, the number of generations attained for each tested isolate was estimated to be 1.41 (*M. incognita* Nishigoshi isolate), 1.49 (*M. incognita* Miyakonojo isolate), 1.45 (*M. incognita* Tsukuba isolate), 1.24 (*M. arenaria* Kikuyo and Kochi-1 isolates), 1.28 (*M. javanica* Kasari isolate), 1.30 (*M. hapla* Koshi isolate), and 1.83 (*P. coffeae* KM4 isolate).

All tested *M. incognita* isolates produced few or no egg masses on the root of Sniper and Tachiibuki in contrast to Haeibuki and Hay-oats (Table 1). In contrast, *M. arenaria*, *M. javanica*, and *M. hapla* isolates produced a few or no egg masses on the root of the four tested cultivars including Sniper. The number of egg masses observed on Sniper was significantly smaller than that on Haeibuki and Hay-oats inoculated with *M. incognita* isolates, and than that on Hay-oats inoculated with *M. arenaria* Kochi-1 isolate and *M. javanica* Kasari isolate.

Table 1. Number of egg masses[1] on the root of tested plants inoculated with 500 second-stage juveniles of root-knot nematode isolates.

Tested plant	*M. incognita* isolate			*M. arenaria* isolate		*M. javanica* Kasari isolate	*M. hapla* Koshi isolate
	Nishigoshi	Miyakonojo	Tsukuba	Kikuyo	Kochi-1		
Sniper	0.1 (n = 39)	0.0 (n = 20)	0.0 (n = 20)	1.2 (n = 20)	0.2 (n = 20)	0.4 (n = 20)	0.1 (n = 20)
Tachiibuki	0.0 (n = 5)	0.0 (n = 5)	0.0 (n = 5)	1.2 (n = 5)	0.0 (n = 4)	0.6 (n = 5)	0.0 (n = 5)
Haeibuki	42.6 * (n = 5)	9.6 * (n = 5)	12.4 * (n = 5)	0.0 (n = 4)	1.0 (n = 4)	1.2 (n = 5)	0.0 (n = 5)
Hay-oats	106.0 * (n = 5)	60.8 * (n = 5)	67.4 * (n = 5)	0.0 (n = 5)	2.0 * (n = 4)	3.6 * (n = 5)	0.0 (n = 5)
Tomato	325.7 * (n = 3)	232.3 * (n = 3)	210.3 * (n = 3)	220.7 * (n = 3)	250.7 * (n = 3)	301.7 * (n = 3)	143.4 * (n = 5)

[1] Significant difference between Sniper and other tested plants is represented by an asterisk (Steel test, $P < 0.05$).

Moreover, the number of eggs and eggshells in the selected intact egg masses produced on Sniper was less than 100 in all isolates with valid data (Table 2). These results suggest that Sniper is, as with Tachiibuki, apparently a poor host for the tested *Meloidogyne* species. Additionally, in a study conducted on the field plots infested with *M. incognita* and *M. arenaria*, fall cropping of Sniper resulted in suppression of nematode increase and yield loss of succeeding sweet potato crop (Katsura and Tateishi, 2013). Therefore, it appears that Sniper can be applied as a rotational crop in fields infested with the tested root-knot nematode species.

No significant difference in the number of *P. coffeae* extracted from the pot was observed between the three tested common oat cultivars (Table 3). Additionally, significantly fewer *P. coffeae* individuals were found on a black oat cultivar Hay-oats than on the three tested common oat cultivars including Sniper. This result suggests that Sniper is less advantageous as a control agent for *P. coffeae* than the other tested cultivars. Uesugi *et al*. (2010) reported that fall cropping of Tachiibuki could result in considerable *P. coffeae* reproduction depending on weather conditions, although the population density of *P. coffeae* after fall cropping of Tachiibuki was not sufficiently high to cause severe damage on succeeding sweet potato in a field plot study. Thus, there can be similar concerns on fall cropping of Sniper.

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Table 2. Number of eggs and eggshells in selected egg masses[1] of root-knot nematode isolates.

Tested plant	*M. incognita* isolate			*M. arenaria* isolate		*M. javanica*	*M. hapla*
	Nishigoshi	Miyakonojo	Tsukuba	Kikuyo	Kochi-1	Kasari isolate	Koshi isolate
Sniper	10.9	–[2]	–	73.9	38.0	79.7	76.1
Tachiibuki	–	–	–	24.5	–	123.2	–
Haeibuki	276.1	34.8	119.6	–	97.8	101.4	–
Hay-oats	258.7	413.0	252.2	–	221.7	745.7	–
Tomato	1,143.5	787.0	1,113.0	934.8	250.7	730.4	1,239.1

[1] Up to 10 intact egg masses were chosen from tested plants inoculated with each root-knot nematode isolate.
[2] No intact egg mass was recovered.

Table 3. Number of *Pratylenchus coffeae* per pot 65 days after inoculation.

Sniper (n = 8)	Tachiibuki (n = 8)	Haeibuki (n = 8)	Hay-oats (n = 8)	Tomato (n = 4)
200.1 b	118.4 b	165.2 b	51.6 c	976.2 a

Values in the row followed by the same lower case letter are not significantly different at 5% level according to Tukey-Kramer test with $\log_{10}(X + 0.5)$ transformed data.

139. (abstract, in Japanese, English title is a translation by the authers)

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