

New Record of *Paratrichodorus minor* (Colbran, 1956) Siddiqi, 1974 and Redescription of *P. porosus* (Allen, 1957) Siddiqi, 1974 (Triplonchida: Trichodoridae) from *Citrus unshiu* Markovich in Korea

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ABSTRACT : During the survey of plant parasitic nematode of Citrus orchard in Korea, *Paratrichodorus minor* (Colbran, 1956) Siddiqi is founded from the soil of *Citrus unshiu* Markovich for the first time in Korea. The body length of females is 428.34~506.22 μm long: a = 12.08~22.79, b = 4.02~5.02, V(%) = 38.46~60.68. The excretory pore is located near the base of esophagus. Additionally, the morphological characteristics on *P. porosus* (Allen, 1957) Siddiqi, 1974 recorded in 1976 on Korea is redescribed in detail.

KEY WORDS : Systematics, Trichodoridae, *Paratrichodorus minor*, *Paratrichodorus porosus*

초 록 : 감귤 과수원의 식물기생선충을 조사하던 중, 한국미기록 선충인 *Paratrichodorus minor*가 처음으로 제주도 감귤과수원 토양에서 발견되었다. *Paratrichodorus minor*는 크기가 428.34~506.22 μm 이고, a = 12.08~22.79, b = 4.02~5.02, V(%) = 38.46~60.68이었으며, 배설공(excretory pore)이 후부식도부에 위치하는 특징을 가지고 있다. 또한, 1976년에 한국에서 보고된 *P. porosus*의 형태적 특징에 관하여 재기술 하였다.

검색어 : 분류, 곤은궁침선충과, *Paratrichodorus minor*, *Paratrichodorus porosus*

The family Trichodoridae Thorne, 1935 are very important nematodes to damage to the root of the crops as well as vectors of plant virus (Decraemer, 1980). At present, it is reported on Korea that Trichodoridae includes five species in two genera: *Trichodorus* Cobb, 1893 and *Paratrichodorus* Siddiqi, 1974 (Choi, 1996). During the survey of plant parasitic nematode of Citrus orchard, an unrecorded species of *Paratrichodorus* was founded. In this paper, morphological characteristics of the species is described and illustrated in detail. *P. porosus* (Allen, 1957) Siddiqi, 1974 was recorded in Korea on 1976 (Lee, 1976). Because of the new morphological character and insufficient descriptions on *P. porosus*, morphological charac-

teristics of the species were additionally redescribed in detail.

Material and Method

The nematode was collected from the soil around the roots of *Citrus unshiu* Markovich in Jeju province, Korea on 2008. The nematodes extracted by modified Baermann funnel method were fixed in hot (80°C) TAF fixative and dehydrated by Seinhorst's rapid glycerin method (Hooper, 1986). The specimens of identification were done with a Key made by Decraemer (Decraemer, 1980,

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1991). Measurements and drawings were made with a microscope equipped with a drawing tube attachment.

Description of Species

Paratrichodorus minor (Colbran, 1956) Siddiqi, 1974, 작은곰은궁침선충

syn. *Trichodorus minor* Colbran, 1956
Nanidorus minor (Colbran, 1956) Siddiqi, 1974
T. christiei Allen, 1957
P. (N.) christiei (Allen, 1957) Siddiqi, 1974
N. christiei (Allen, 1957) Siddiqi, 1974
P. (N.) obesus (Razjivin & Penton, 1975)
 Rodriguez-M & Bell, 1978

Measurements: see Table 1.

Female: Body cylindrical and curved ventral after killing by hot fixative. Cuticle smooth and slightly swell from subcuticle. No lateral body pores. Head not set off. Amphids opening slitlike and cup-shaped. Onchiostylet 24.89~31.44 μm . Excretory pore located near the base of esophageal. Oesophagus ventral overlapping slightly. No cervical papilla. Vulva a small, transverse slitlike. Vaginal sclerotization not developed and shorter than half of the body width. Spermatica not observed. Tail short, hemispherical.

Male: not founded

Discussion on morphometric characteristics: Morphological characters of this specimens are similar to those of Allen's descriptions (Allen, 1957). However, this specimen is smaller than Siddiqi and Shishida's morphometric data (Shishida, 1979 and Siddiqi, 1963, 1973).

Table 1. Measurement comparison of *Paratrichodorus minor*

Characters	Female	
	Jeju n=13	Allen (1957) n=20
L (μm)	471.27 \pm 27.86 ^a (428.34~506.22) ^b	460~710
Body width (μm)	26.20 \pm 6.56 (19.65~41.92)	
Neck length (μm)	84.17 \pm 1.65 (82.53~86.46)	
Onchiostylet length (μm)	29.58 \pm 2.05 (24.89~31.44)	33~47
Fore end to excretory pore (EP) (μm)	89.74 \pm 2.27 (87.77~93.01)	
Anterior ovary (μm)	106.30 \pm 8.99 (90.39~120.52)	16~24
Posterior ovary (μm)	92.82 \pm 19.45 (57.64~111.35)	13~26
Ratio a	18.81 \pm 3.37 (12.08~22.79)	15~20
Ratio b	4.47 \pm 0.30 (4.02~5.02)	4.6~6.0
Ratio V	51.97 \pm 9.12 (38.46~60.68)	50~56
Fore end to EP/neck length (%)	106.61 \pm 0.65 (106.25~107.58)	
Onchiostylet length/neck length (%)	36.18 \pm 1.07 (34.92~37.5)	

^a mean \pm standard deviation.

^b range (min~max).

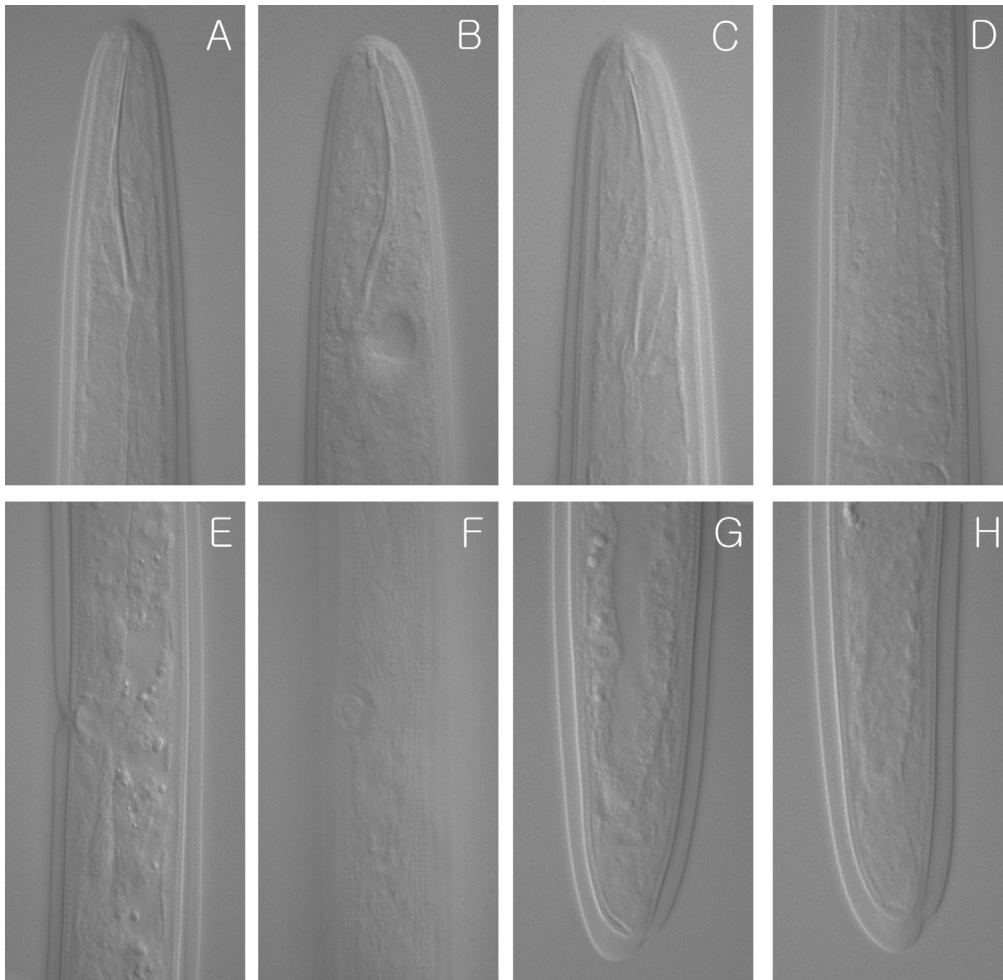


Fig. 1. Photomicrographs of *Paratrichodorus minor*: A, B, C: Female anterior part; D: Female base of esophagus; E: Female vulva region; F: Lateral view of vulva; G, H: Female tail.

Locality and host: Seoqwipo city, Jeju province (*Citrus unshiu* Markovich)

It was reported that *P. minor* was founded in various plants and trees (Allen, 1957; Shishida, 1979; Bell *et al.*, 2001; Decraemer, 1991). Also the species was widely distributed in many countries of world. However, the species collected in this time was only founded in one sampling site of Jeju province. So it is assumed that the species is distributed in restricted sites in Korea. To get the distributional state of the species, it is necessary to investigate the distribution of *P. minor* intensively.

***Paratrichodorus porosus* (Allen, 1957) Siddiqi, 1974, 배추곰은궁침선충**

syn. *Trichodorus porosus* Allen, 1957

P. (Allotrichodorus) porosus (Allen, 1957) Siddiqi, 1974

A. porosus (Allen, 1957) Siddiqi, 1974

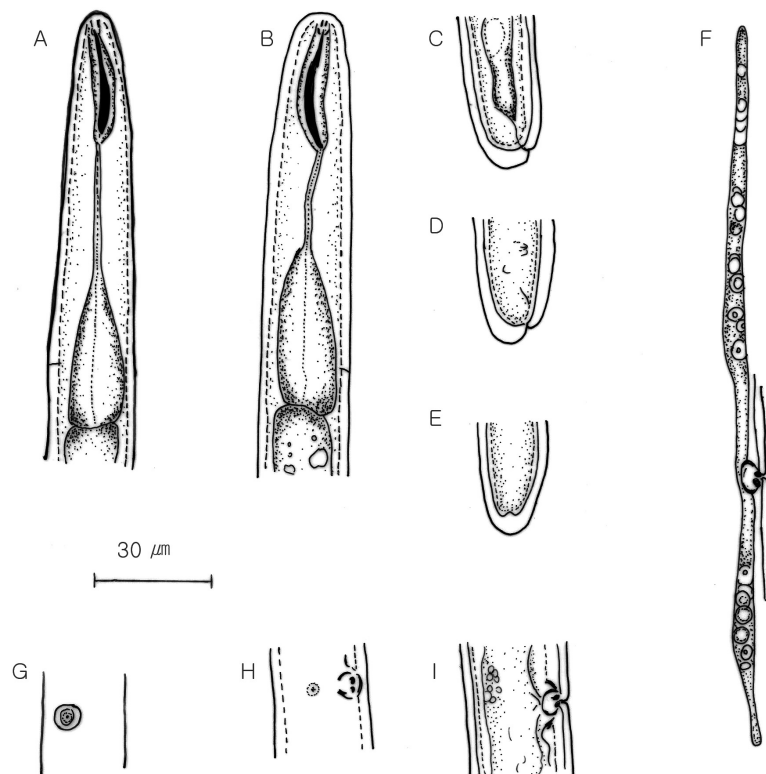
T. bucrius Lordello & Zamith, 1958

Measurements: see Table 2.

Female: Body cylindrical, well swelled and cuticle smooth. Lip region set off. Amphids opening slitlike and cup-shaped. Onchiostylet 32.75–56.33 μm . Excretory pore located middle of the oesophagus. Oesophagus slightly overlaps intestine ventrally. A pair of ventromedian pores located anterior and posterior to the vulva. Vulva opening small and porelike. Cutinized pieces are small and inconspicuous. The female gonad paired. Spermatoca inconspicuous. Tail short, hemispherical. Caudal pores present.

Table 2. Measurement comparison of *Paratrichodorus porosus*

Characters	Female		
	Jeju n=25	Allen (1957) n=16	Lee (1976) n=10
L (μm)	584.91 \pm 82.14 ^a (382.91~772.31) ^b	460~770	510 (400~720)
Body width (μm)	35.60 \pm 4.67 (26.2~48.47)		
Neck length (μm)	79.61 \pm 6.58 (64.19~86.46)		
Onchiostylet length (μm)	48.13 \pm 4.78 (32.75~56.33)	43~50	46.0 (40.8~48.2)
Fore end to excretory pore (EP) (μm)	87.27 \pm 6.25 (72.05~95.63)		
Anterior ovary (μm)	146.72 \pm 18.53 (125.76~188.64)	19~28	
Posterior ovary (μm)	132.86 \pm 13.91 (110.04~158.51)	12~25	
Ratio a	16.47 \pm 1.53 (14.06~19.65)	15~25	21.0 (16.3~27.0)
Ratio b	4.40 \pm 0.55 (3.28~5.51)	4.1~5.5	4.6 (4.0~5.3)
Ratio V	53.63 \pm 8.20 (39.62~73.17)	53~58	65.1 (50.5~60.8)
Fore end to EP/neck length (%)	109.76 \pm 3.30 (104.62~118.18)		
Onchiostylet length/neck length (%)	62.15 \pm 6.20 (54.55~74.14)		

^a mean \pm standard deviation^b range (min~max)**Fig. 2.** Diagrams of *Paratrichodorus minor*: A, B: Female anterior part; C, D, E: Female tail; F: Female gonad; G: Lateral view of vulva; H, I: Vulva region.

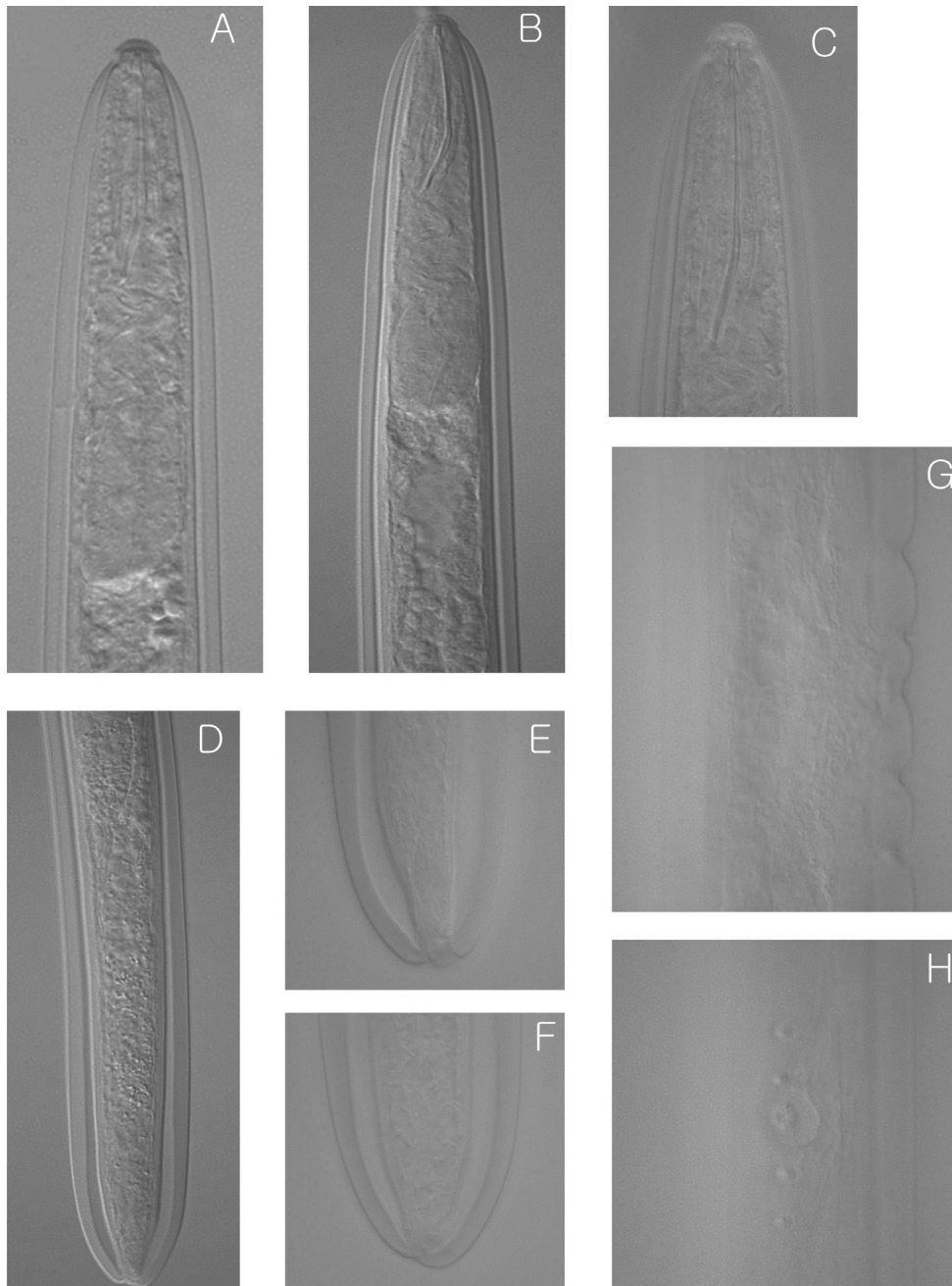


Fig. 3. Photomicrographs of *Paratrichodorus porosus*: A, B, C: Female anterior part; D, E, F: Female tail; G: Vulva region; H: Lateral view of vulva.

Male: not founded

Discussion on morphometric characters: The species was firstly reported as *P. poresus* in 1976 on Korea (Lee, 1976). That was a mistake of *P. porosus*. It was reported that *P. porosus* had various ventromedian pores anterior and posterior to the vulva (Allen, 1957; Siddiqi, 1962). Japanese specimens had frequently three advulvar pores

(two anterior, one posterior; or one anterior, two posterior) (Decraemer, 1991). However Lee (1957) reported that *P. porosus* had four ventromedian pores. The species founded in Jeju province has also same number of ventromedian pores except one nematode (three ventromedian pores: two anterior, one posterior). As a result of this, it is assumed that *P. porosus* founded in Korea has generally four ventromedian pores.

Locality and host: Seoqwipo city, Jeju province (*Citrus unshiu* Markovich).

This species has wide host range and distribution (Shishida, 1979; Decraemer, 1991). *P. porosus* was founded around soil at the root of soybean, garlic, chinese cabbage and maize in Korea (Lee, 1976). However, there was no the data of regional distribution.

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