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Intriguing taxonomic case of *Pratylenchus vanderbergae* : recognition as a separate species and its significant impact on various crops

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The genus *Pratylenchus* encompasses a diverse group of nematodes with significant implications in Agriculture. Only 24 *Pratylenchus* spp. have been reported in Africa to date. However, cryptic biodiversity within the genus *Pratylenchus* exists, suggesting actual diversity of *Pratylenchus* nematodes maybe underestimated. Undescribed and cryptic species could complicate nematode management strategies, quarantine, biodiversity conservation and food security efforts. Because *Pratylenchus* spp. vary in pathogenicity and reproduction, accurate characterization is essential in agriculture and could have implications on crop production.

Pratylenchus populations were isolated from finger millet in Kenya and from maize, potato, tomato and soybean from South Africa. Based on light microscopy and sequences of D2-D3 of 28S rDNA and internal transcribed spacer (ITS) of rDNA, these populations were found to be conspecific and molecularly identical to *P. teres teres*, and to *P. teres vanderbergae* based on sequences of D2-D3 of 28S rDNA and the heat shock protein *Hsp90*. However, due to discernible morphological differences compared to the original description of *P. teres* and their distinct geographical distribution, *Pratylenchus vanderbergae* stat. nov. is recognized as a separate species.

Morphological analysis

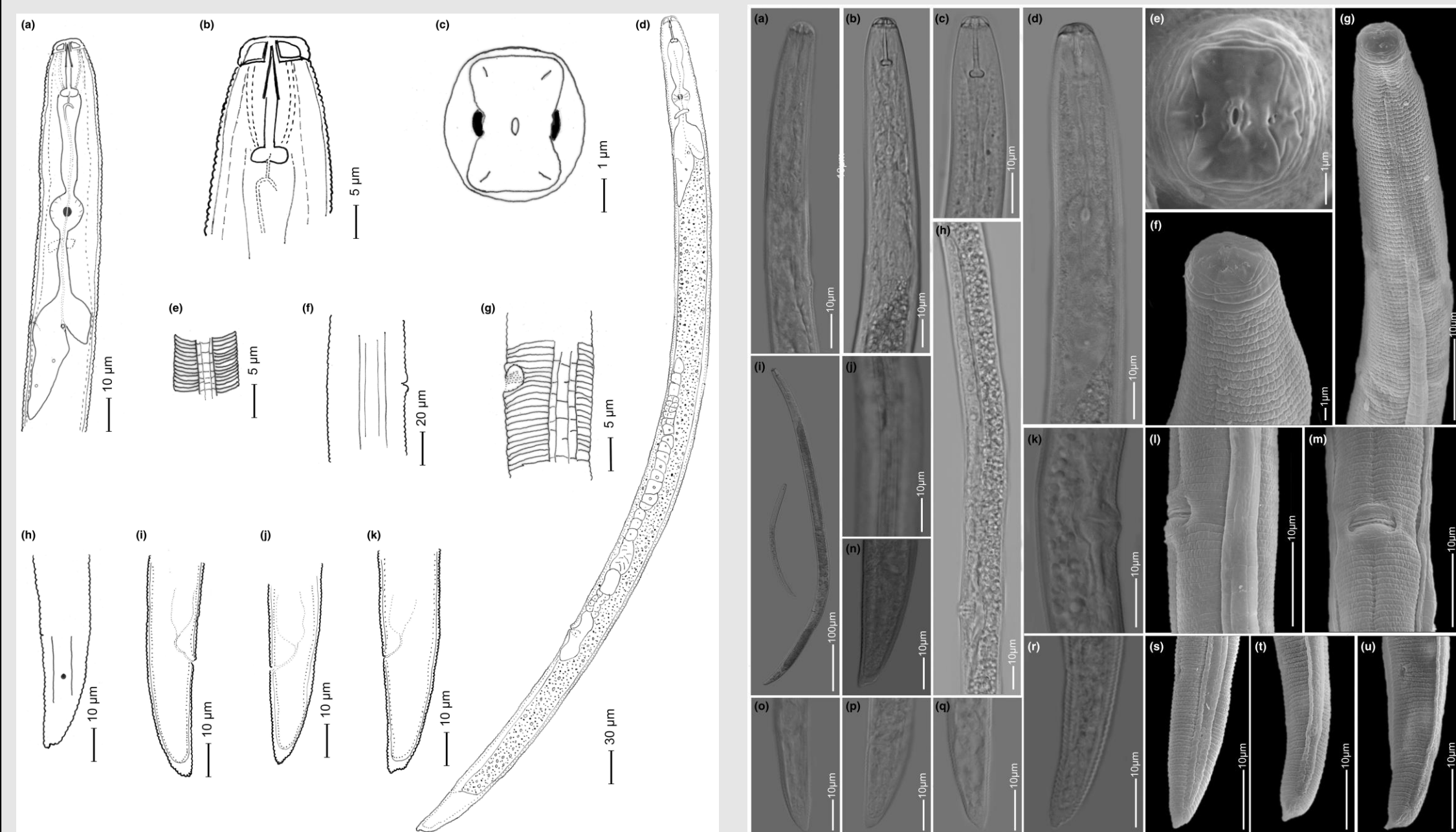


Fig. 1 *Pratylenchus vanderbergae* stat. nov. line drawings. (a, b) Female anterior region, (c) en face view, (d) entire body of female, (e-g) variation in lateral lines (e, juvenile mid-body; f, g vulva region), (h-k) variation in tail shape.

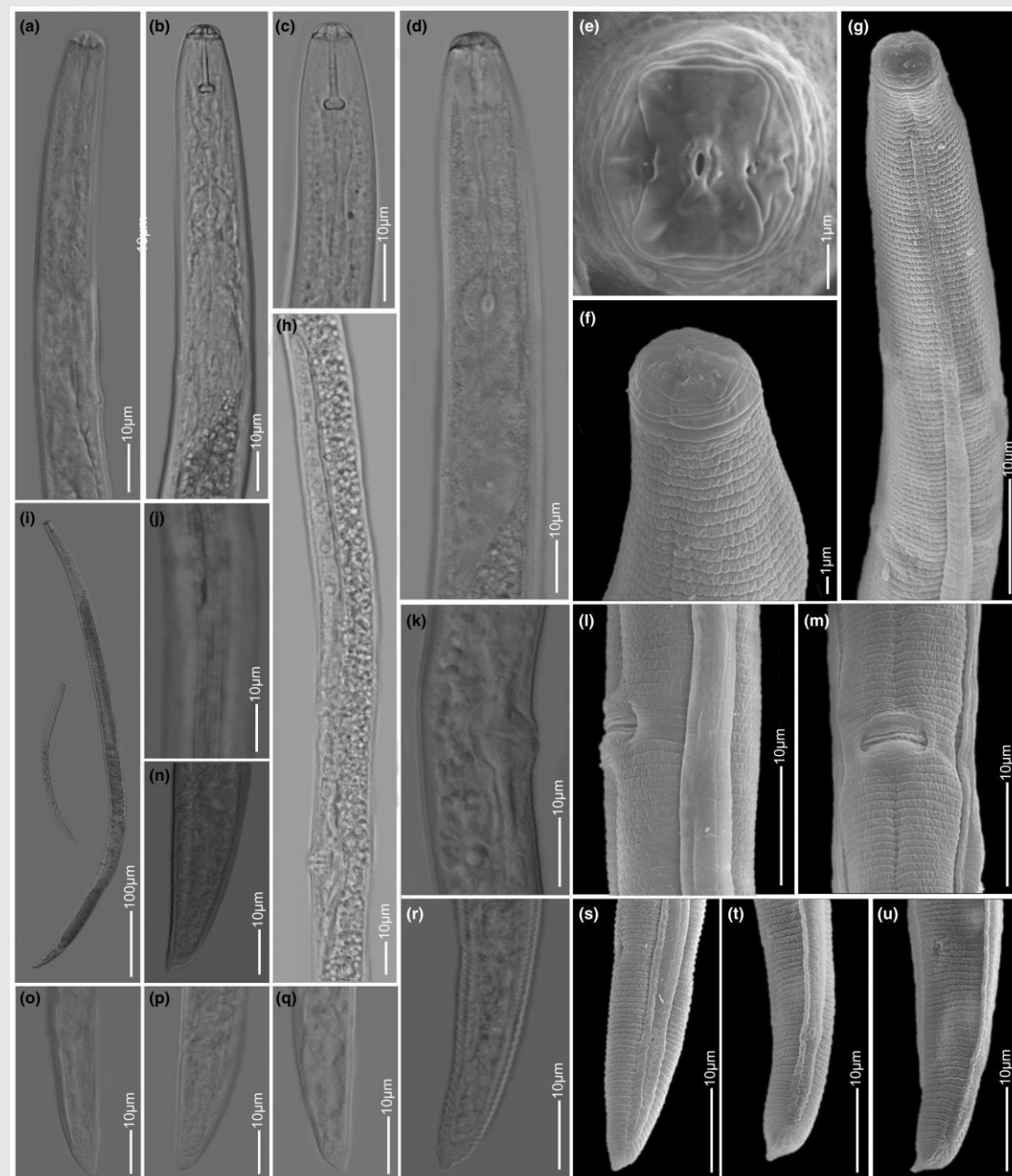


Fig.2 Light and scanning electron microscopy (SEM) photographs of *Pratylenchus vanderbergae* stat. nov. (a-d) Female anterior and pharyngeal regions, (e-g) SEM images of female head region, (h) female reproductive system, (i) entire female and juvenile body, (j) lateral field in female mid-body, (k) vulva region, (l, m) SEM images of female vulva region, (n-r) variation in tail shape and tail tip of female, (s-u) SEM images of female tail.

Pratylenchus vanderbergae stat. nov. previously known as the subspecies *P. teres vanderbergae*, now recognized as a separate species based on morphological differences with the original description and geographical distribution

Morphological comparisons

Species	Morphological characteristics										
	A ₁₋₃	B ₁₋₂	C ₁₋₅	D ₁₋₄	E ₁₋₄	F ₁₋₆	G ₁₋₃	H ₁₋₄	I ₁₋₄	J ₁₋₃	K ₁₋₂
<i>Pratylenchus vanderbergae</i> stat. nov.	2,3	1	2,3	1	1,2	2,3,4,5	1,2,3	2	1,2,3	1	2
<i>P. oleae</i>	2	1	2,3	2	2,3	3,4,5	2,3	2	1,2	1	2
<i>P. teres</i>	2	1	2	1	1	3	3	2	3	3	1
<i>P. subnigri</i>	2	1	3	1	2	5	3	2	3	1	2
<i>P. sensillatus</i>	2	1	2	1	2	5	2	1	3	1	2
<i>P. bolivianus</i>	2	1	4	1	3	4	3	1	2	1	2

Table 1. Comparison of *Pratylenchus vanderbergae* stat. nov. with morphologically similar species

	Khan & Singh (1974) <i>Pratylenchus teres</i> original description				Van den berg & Quenée (2000)		Present paper		Carta et al (2002)	
	Holotype	Paratypes	Amritsar	Solan	Guadeloupe	Kenya & South Africa	<i>P. teres teres</i>	<i>P. teres vanderbergae</i>	<i>P. teres teres</i>	<i>P. teres vanderbergae</i>
n	1	5	17	4	8	43	20	32	20	32
L	400	400-420	420-630	520-600	472-531	403-683	470-630	500-640	470-630	500-640
a	21	21-23	22-40	29-31	29-31	21-31	25-35	20-30	25-35	20-30
b	4.2	4.1-4.2	3.5-5.6	3.9-5.5	4	3.4-7.3	3.2-5.5	3.7-4.9	3.2-5.5	3.7-4.9
c	14	14-16	12-27	15-18	13-16	12-21	15-18	15-18	15-18	15-18
d	70	70-77	69-78	72-75	69-74	71-76	69-76	71-77	69-76	71-77
Stylet length	18	17-18	16-18	17-18	17-18	14-17	16-17	15-16	16-17	15-16
Dorsal gland opening from stylet base	3	-	-	-	3	1.5-4.6	3	2-3	3	2-3
Anterior end to secretory-excretory pore	-	-	-	-	77-85	61-101	80-87	80-90	80-87	80-90
Anterior to pharyngeal gland end	-	-	-	-	121-137	82-151	115-155	112-136	115-155	112-136
Pharyngeal overlap	-	-	-	-	33-40	12-47	35-47	31-42	35-47	31-42
Post-uterine sac	1 vulval body diameters	1.5-2.5 anal body diameters	-	-	31-39	25-42	30-37	30-36	28-35	20-35
Tail length	25	24-30	-	-	27-34	17-35	27-35	23-35	27-35	23-35
Lines in lateral field	6	6	6	6	6	4	4	4-5 central fifth line interrupted 3-4 (mostly 4)	4	4
Lip annuli	3	3	3	3	3	3	3	3	3	3

Table 2. Comparison of *Pratylenchus teres* populations, its redescription and respective subspecies and populations in the current study

Phylogenetic analysis

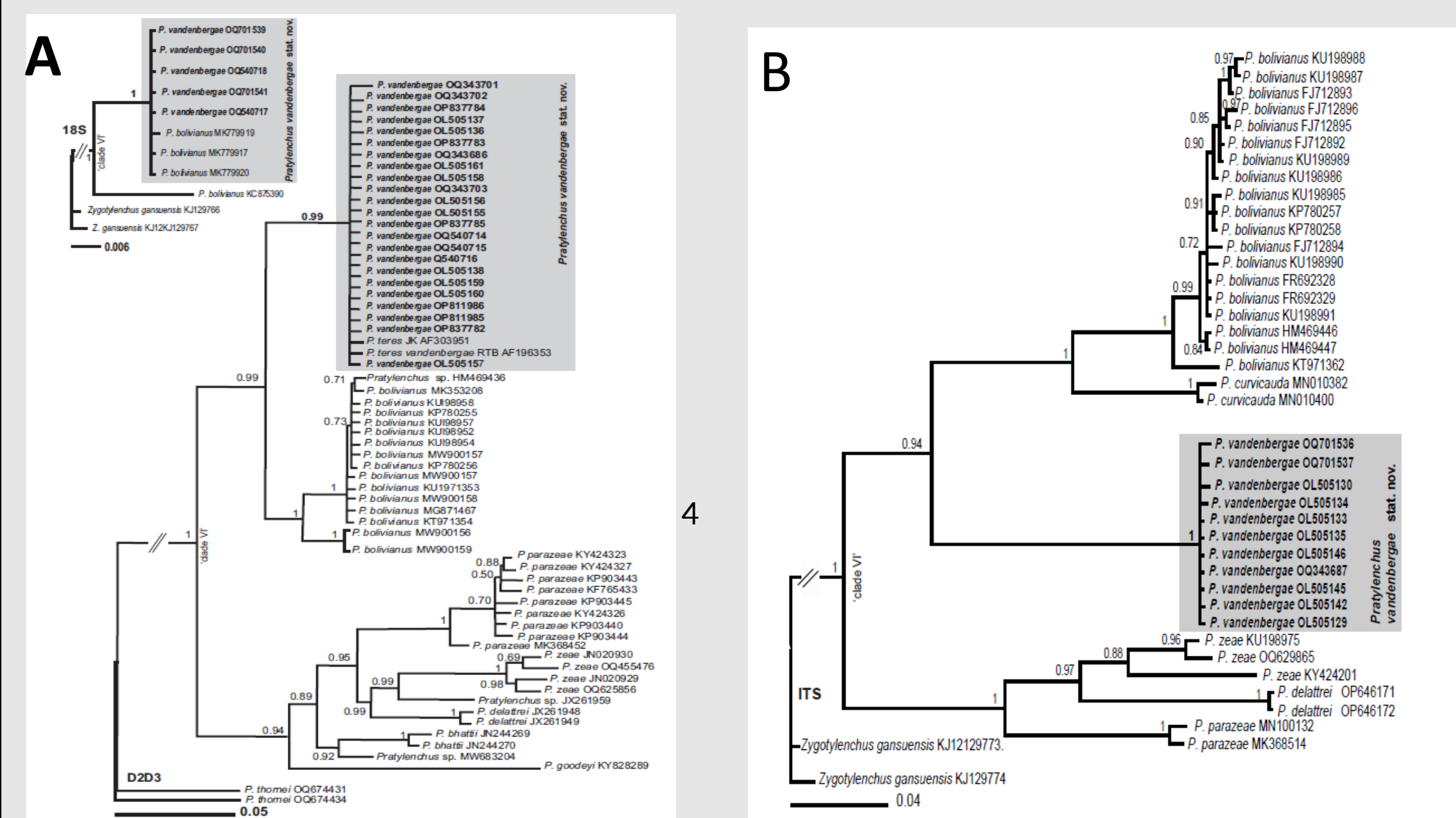


Fig. 3 Bayesian inference phylogenetic relationships within the genus *Pratylenchus* of Clade VI (Subbotin et al., 2008; Troccoli et al., 2016) generated from the A) 18S rDNA and D2-D3 of 28S rDNA and B) ITS rDNA gene sequences. New sequences of *Pratylenchus vanderbergae* stat. nov. are indicated in bold.

Pratylenchus vanderbergae stat. nov., previously misidentified as *P. bolivianus* due to sequence similarities despite molecular and morphological differences

Pathogenicity and Lifecycle

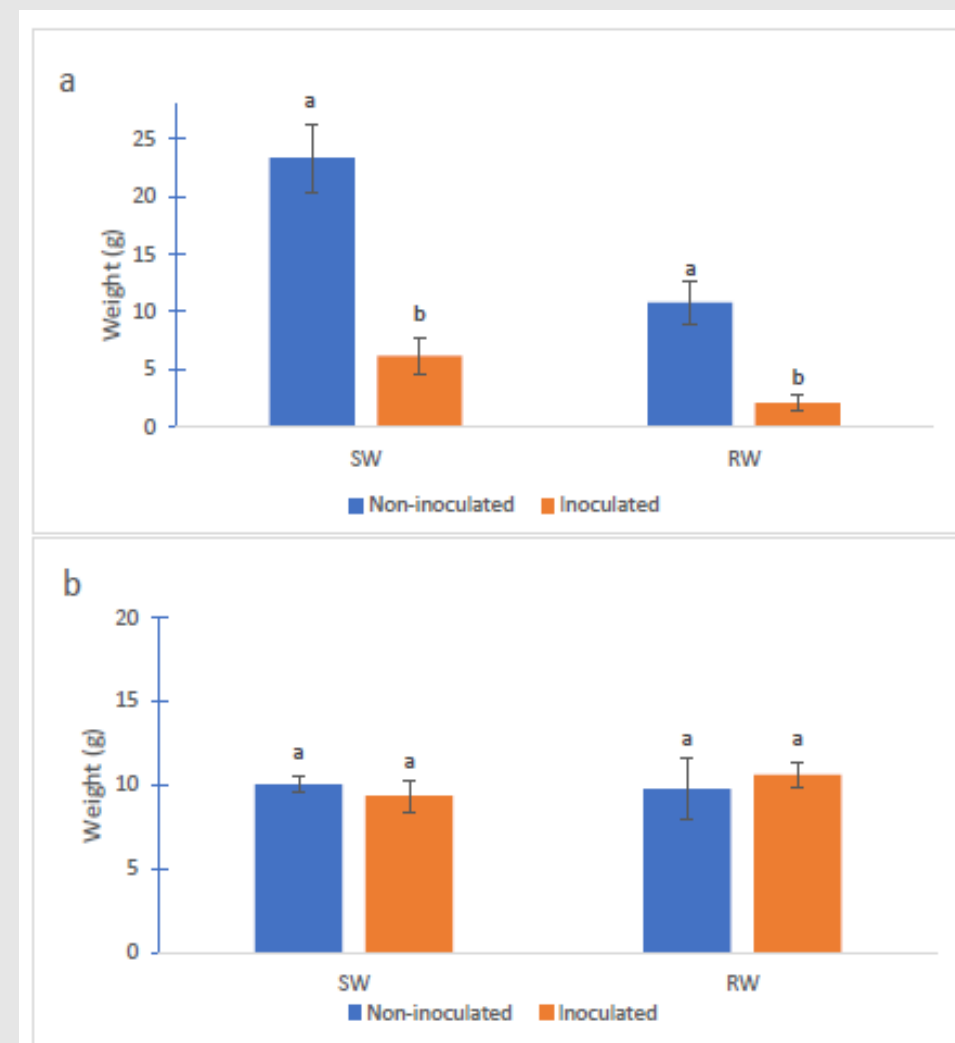


Fig. 4. *Pratylenchus vanderbergae* stat. nov. considerably reduced shoot and root weight in OKHALE-1 but not KNE1034

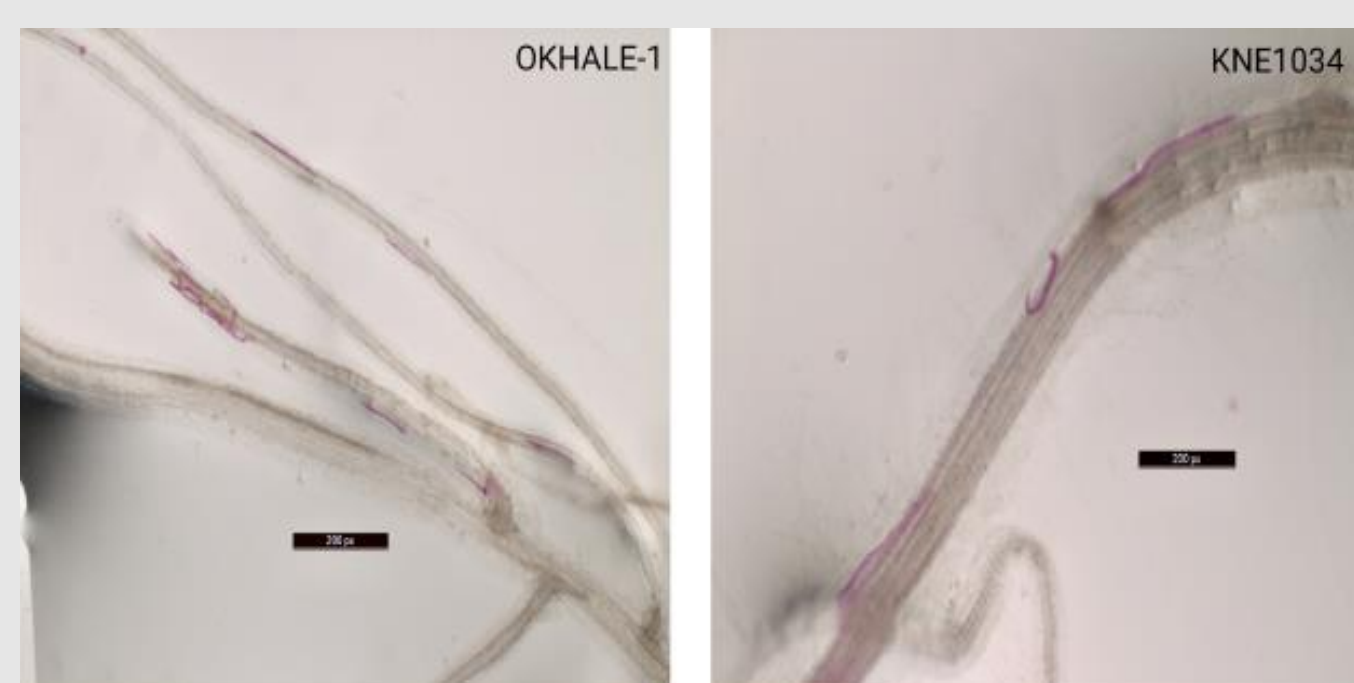


Fig. 5 Acid fuchsin-staining revealed the presence of *Pratylenchus vanderbergae* stat. nov. within the roots of OKHALE-1 and KNE1034 finger millet genotypes

Crop	Rf	Nematodes/g roots	Index of Susceptibility
Maize (cv. P2927WVR)	1.11 ± 0.70 a	216 ± 131.98 a	1
Soybean (cv. RA4918R)	0.50 ± 0.22 b	141 ± 62.93 a	0.65
Sunflower (cv. PAN7090)	0.01 ± 0.01 c	4.5 ± 2.07 b	0.02
Tomato (cv. Roma)	0.02 ± 0.02 c	3.8 ± 3.78 b	0.02

Table 3. Reproductive potential and susceptibility index of various crops to *Pratylenchus vanderbergae* stat. nov.

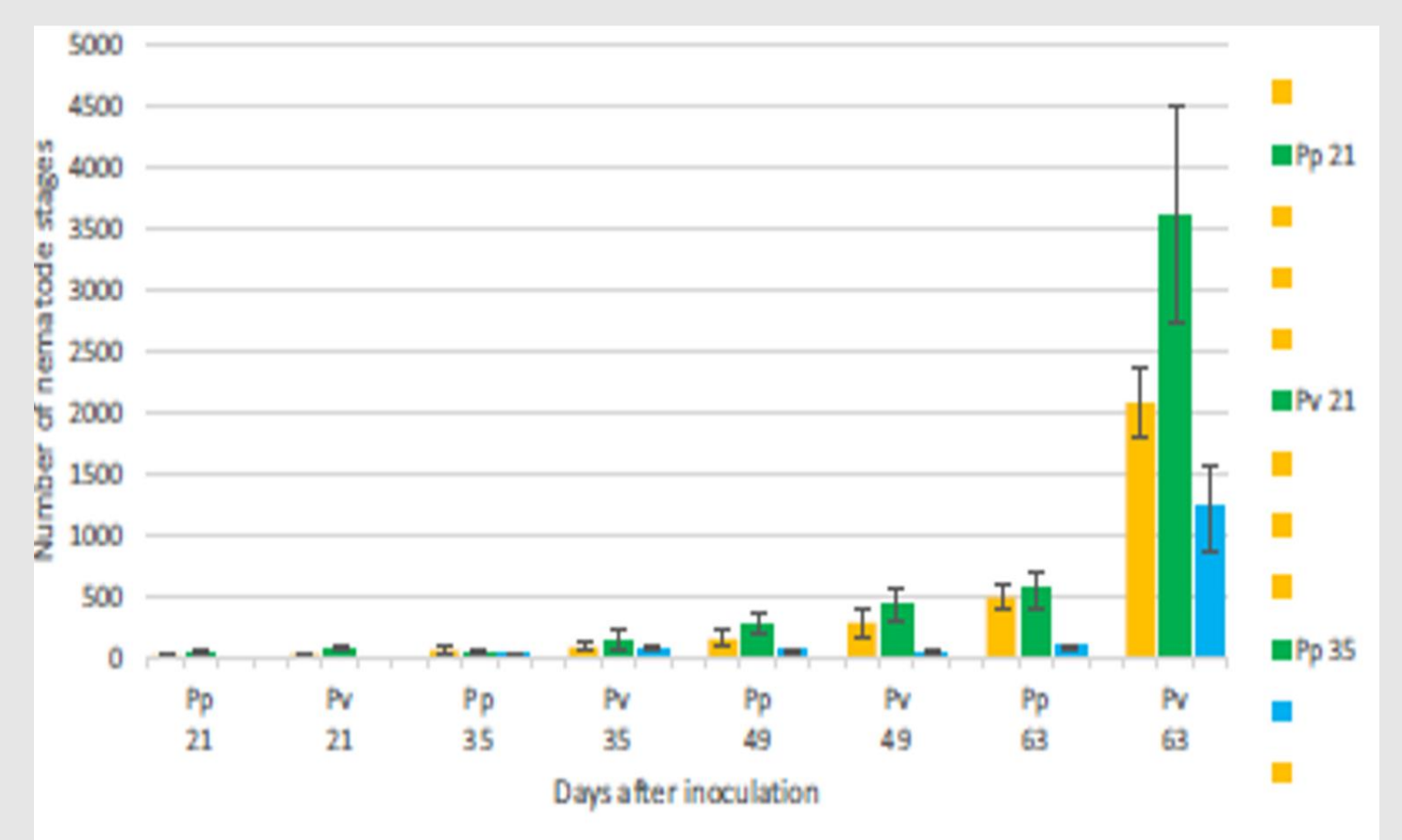
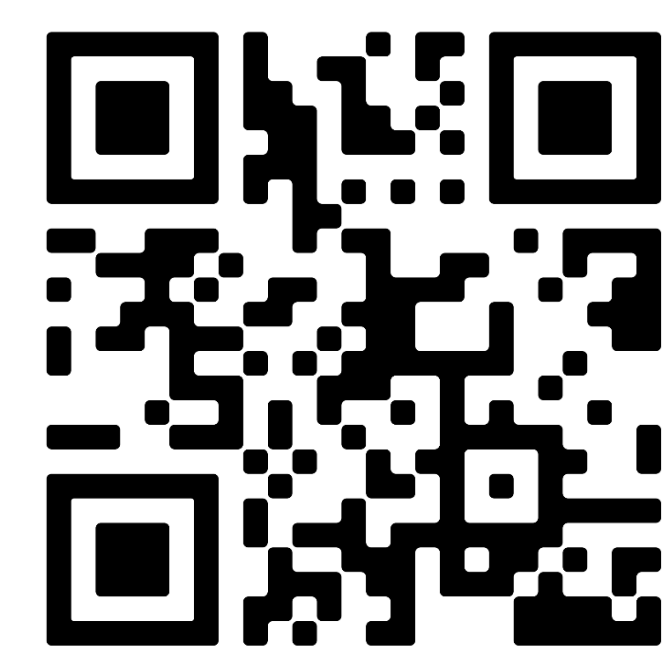


Fig. 6 *Pratylenchus vanderbergae* stat. nov. exhibits a life cycle of similar length to *Pratylenchus penetrans* in carrot discs, but demonstrates considerably greater reproduction

In conclusion, pathogenicity studies, host susceptibility and life cycle studies show that *Pratylenchus vanderbergae* stat. nov. is an important agricultural pest with a wide distribution and this study provides a comprehensive understanding of its interactions with various hosts. This underscores the need for improved surveillance and management strategies of this nematode to curb further spread.

Reference; Carta, L.K., Handoo, Z.A., Skantar, A.M., Van Biljon, J. & Botha, M. (2002) Redescription of *Pratylenchus teres* Khan & Singh, 1974 (Nemata:Pratylenchidae), with the description of a new subspecies from South Africa, and a phylogenetic analysis of related species. *African Plant Protection*, 8, 13–24.



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