

Plant-parasitic nematodes associated with potatoes

By Dr Mariette Marais, Dr Chantelle Girgan, Dr Kgabo Pofu, Dr Estianne Retief, Mrs Adoration Shubane, Dr René Sutherland, Dr Antoinette Swart, Dr Mariette Truter and Dr Jacques van Zyl

This paper is an update of the paper *Plant nematodes in South Africa. 13. A checklist of nematodes associated with potatoes* (Marais *et al.*, 2015). The South African Plant-Parasitic Nematode Survey (SAPPNS) was launched in 1987 by the Nematology Unit, Biosystematics, ARC-Plant Health and Protection with the main objective of making an inventory of all the plant-parasitic nematodes found in South Africa (Marais *et al.*, 2017).

The primary sources of data were the information contained in the National Collection of Nematodes (NCN), data from the plant-parasitic nematodes collected in South Africa since the 1950s and published information. Only information from which the locality could be geo-referenced was read into the database. Systematic surveys, undertaken by NCN personnel, Nematology Unit diagnostic service data and published datasets, such as Visagie *et al.* (2018), were used as secondary information resources.

The information contained in both the SAPPNS and NCN databases is published at intervals as part of the *Plant nematodes in South Africa* series of publications (Marais & Swart, 1998, 2014; Marais *et al.*, 2015).

This paper also includes information from the following Potatoes SA-funded projects (Marais *et al.*, 2022; Pofu *et al.*, 2021; Retief *et al.*, 2022; Sutherland & Truter, 2022; Sutherland *et al.*, 2022):

- Succession of nematodes in an Eastern Free State potato rotation.
- Suitability of 16 crops used by potato producers in crop rotations for managing three root-knot nematodes.

- Diversity of the black dot pathogen and plant-parasitic nematodes in the Limpopo province.
- A survey to investigate the causal organisms involved with potato early dying in the Limpopo province.
- Control strategies for potato early dying in the Limpopo province.
- Conservation farming practices for potato production in the Sandveld.

Classification of nematodes

The classification of South African plant-parasitic nematodes followed here is a synthesis of the classification of Maggenti *et al.* (1988), Geraert (2011) and Castillo & Vovlas (2007) for Tylenchina, Hunt (1993) for Aphelenchida, Decraemer (1995) and Duarte *et al.* (2010) for Trichodoridae, as well as the classification of Yeates *et al.* (1993) for plant feeding nematodes.

A query ran in the database gleaned a dataset of 342 potato records sampled from 1947 to December 2022. The datasets were sorted into the 16 production areas of Potatoes SA and are recorded in *Table 1*. Currently, according to the SAPPNS and NCN databases, 500 plant-feeding nematodes have been reported from South Africa (Marais, 2022) with 21% of these associated with potatoes.

The long-held belief that the datasets regarding nematodes associated with potatoes are patchy, with some areas with nearly no information, is clearly illustrated in this table, with little information in the databases especially for the Southern Cape, Eastern Cape, Loskop Valley, Southwestern Free State and Western Free State potato producing areas.

In 1996 the book *Plant Nematodes of South Africa* was published, summarising the data contained in the NCN and in the SAPPNS database. In this publication, 39 plant-parasitic nematodes were listed as associated with potatoes (Kleynhans *et al.*, 1996), compared to the 95 species reported by mid-2015 and then 105 at the end of 2022 (Marais *et al.*, 2015).

Cyst nematodes in the Sandveld

Please note that the table contains plant-parasitic nematodes associated with potatoes or those found in potato fields but is not necessarily a list of nematodes that are parasites or pathogens of potatoes. More specifically, please note the description of *Globodera capensis* from a potato field in the Sandveld (Knoetze *et al.*, 2013). The discovery of this cyst nematode was of great concern for potato growers, but reproductive tests at that stage indicated that potatoes are not a host of this cyst nematode (Knoetze *et al.*, 2013).

Globodera sandveldensis was subsequently also described from the Sandveld, raising similar concerns but with the main difference that *G. sandveldensis* was not reported from a potato field (Knoetze *et al.*, 2017). The stubby root nematode *Nanidorus minor*, one of the vectors of Tobacco rattle virus (TRV), the causative agent of corky ring disease on potatoes, was reported from all 16 production areas, but only on potatoes in 13 of the production areas. (Decraemer, 1995). Of the three other vectors of TRV, namely *Paratrichodorus allius*, *P. porosus* and *P. teres*, only *P. porosus* was found to be associated with potatoes in the Gauteng, Limpopo and Eastern Free State potato production regions.

Table 1: Dataset of potato records sampled from 1947 to December 2022 in 16 South African potato production regions.

Nematodes	Common name	Southern district				Northern district				Central district			Eastern district			Total		
		Ceres	Southwestern Cape	Southern Cape	Sandveld	Eastern Cape	Gauteng	Limpopo	Mpumalanag	Loskop Valley	Northern Cape	Southwestern Free State	Western Free State	North West	Eastern Free State		KwaZulu-Natal	Northeastern Cape
Number of records		16	15	4	89	2	27	26	48	9	18	4	5	19	12	28	20	342
Family Anguinidae																		
<i>Ditylenchus africanus</i> Wendt, Swart, Vrain & Webster, 1995	Peanut pod nematode															1		1
Family Dolichodoridae																		
<i>Geocenamus</i> Thoren & Malek, 1968	Stunt nematode				1		1											2
<i>Geocenamus brevidens</i> (Allen, 1955) Brzeski, 1991	Stunt nematode					1				1							7	9
<i>Quinisulcius</i> Siddiqi, 1971	Stunt nematode						1										2	3
<i>Quinisulcius capitatus</i> (Allen, 1955) Siddiqi, 1971	Stunt nematode				1			1					1					3
<i>Telotylenchus</i> Siddiqi, 1960	Stunt nematode						2											2
<i>Telotylenchus avaricus</i> Kleynhans, 1975	Stunt nematode											1						1
<i>Telotylenchus ventralis</i> Loof, 1963	Stunt nematode	1			1	2	8	2	2				1				1	18
<i>Telotylenchus verutus</i> Kleynhans, 1975	Stunt nematode								2									2
<i>Tylenchorhynchus</i> Cobb, 1913	Stunt nematode				4	7	7	6	3	4			3	1	1			36
<i>Tylenchorhynchus brevilineatus</i> Williams, 1960	Stunt nematode				1	5	10	4	2				4					26
<i>Tylenchorhynchus claytoni</i> Steiner, 1937	Stunt nematode						1											1
<i>Tylenchorhynchus mashhoodi</i> Siddiqi & Basir, 1959	Stunt nematode						1	1										2
Family Pratylenchidae																		
<i>Pratylenchus</i> Filipjev, 1936	Lesion nematode	1	1		5	5	10	5	5	1		2	1	6	3	1		46
<i>Pratylenchus brachyurus</i> (Godfrey, 1929) Filip'ev & Schuurmans Stekhoven, 1941	Lesion nematode					2		6	1							2		11
<i>Pratylenchus delattrei</i> Luc, 1958	Lesion nematode								1					1	1			3
<i>Pratylenchus flakkensis</i> Seinhorst, 1968	Lesion nematode	1																1
<i>Pratylenchus hexincisus</i> Taylor & Jenkins, 1957	Lesion nematode			1													1	2
<i>Pratylenchus neglectus</i> (Rensch, 1924) Filip'ev & Schuurmans Stekhoven, 1941	Lesion nematode		2	1						3		1	2					9
<i>Pratylenchus penetrans</i> (Cobb, 1917) Filip'ev & Schuurmans Stekhoven, 1941	Lesion nematode	2	3		2							2						9
<i>Pratylenchus pratensis</i> (De Man, 1880) Filip'ev, 1936	Lesion nematode							1										1
<i>Pratylenchus scribneri</i> Steiner, 1943	Lesion nematode						1						1	1				3
<i>Pratylenchus teres</i> Khan & Singh, 1975	Lesion nematode					1		1										2
<i>Pratylenchus thornei</i> Sher & Allen, 1953	Lesion nematode									1			1					2
<i>Pratylenchus vulnus</i> Allen & Jensen, 1951	Lesion nematode							3										3
<i>Pratylenchus zeae</i> Graham, 1951	Lesion nematode	1			2	10	7	16	2			1	7	2	4			52

Table 1 (continued): Dataset of potato records sampled from 1947 to December 2022 in 16 South African potato production regions.

Nematodes	Common name	Southern district				Northern district				Central district			Eastern district		Total		
		Ceres	Southwestern Cape	Southern Cape	Sandveld	Eastern Cape	Gauteng	Limpopo	Mpumalanag	Loskop Valley	Northern Cape	Southwestern Free State	Western Free State	North West		Eastern Free State	KwaZulu-Natal
<i>Zygotylenchus guevarai</i> (de Guiran, 1964) Braun & Loof, 1966	Lesion nematode							1									1
<i>Zygotylenchus natalensis</i> Van den Berg & Tiedt, 2003	Lesion nematode														1		
Family Hoplolaimidae																	
<i>Hoplolaimus</i> Von Daday, 1905	Dagger nematode	1	1													1	3
<i>Hoplolaimus pararobustus</i> (Schuurmans Stekhoven & Teunissen, 1938) Sher in Coomans, 1963	Dagger nematode				3					2							5
<i>Rotylenchus</i> Filipjev, 1936	Spiral nematode	1					5	2							2		10
<i>Rotylenchus abnormecaudatus</i> Van den Berg & Heyns, 1974	Spiral nematode														1		
<i>Rotylenchus brevicaudatus</i> Colbran, 1962	Spiral nematode		2		2	1		1									6
<i>Rotylenchus capensis</i> Van den Berg & Heyns, 1974	Spiral nematode									1			1				2
<i>Rotylenchus incultus</i> Sher, 1965	Spiral nematode						1										1
<i>Rotylenchus karoensis</i> Van den Berg, 1986	Spiral nematode							1									1
<i>Rotylenchus unisexuatus</i> Sher, 1965	Spiral nematode				1	1	10							2	5		19
<i>Helicotylenchus</i> Steiner, 1945	Spiral nematode	1	1		4	2	6	9		1		1	1	2	6	1	35
<i>Helicotylenchus cavenessi</i> Sher, 1966	Spiral nematode							2									2
<i>Helicotylenchus dihystrer</i> (Cobb, 1893) Sher, 1961	Spiral nematode		3	1	2		7	4	10	5	1		2	1	2	3	41
<i>Helicotylenchus indicus</i> Siddiqi, 1963	Spiral nematode								2						2		4
<i>Helicotylenchus martini</i> Sher, 1966	Spiral nematode						1										1
<i>Helicotylenchus minzi</i> Sher, 1966	Spiral nematode							1								1	2
<i>Helicotylenchus paraplatyurus</i> Siddiqi, 1972	Spiral nematode					2		1		1							4
<i>Helicotylenchus pseudorobustus</i> (Steiner, 1914) Golden, 1956	Spiral nematode							1									1
<i>Scutellonema</i> Andrassy, 1958	Spiral nematode				1	2	5	3	1			1	1	3			17
<i>Scutellonema bizanae</i> Van den Berg & Heyns, 1973	Spiral nematode					1									1		2
<i>Scutellonema brachyurus</i> (Steiner, 1938) Andrassy, 1958	Spiral nematode		1		2	8	7	20	5	1		2	5	5	5		61
<i>Scutellonema cavenessi</i> Sher, 1964	Spiral nematode							2									2
<i>Scutellonema truncatum</i> Sher, 1964	Spiral nematode					2	3	1		1						3	10
<i>Rotylenchulus</i> Linford & Oliveira, 1940	-				1		2	2				1			4		10
<i>Rotylenchulus clavicaudatus</i> Dasgupta, Raski & Sher, 1968	-				1												1
<i>Rotylenchulus parvus</i> (Williams, 1960) Sher, 1961	-				1		10	7	3			1	1	1	1	4	29

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Family Heterodae																	
<i>Heterodera</i> A Schmidt, 1871	Cyst nematode				2			1									3
<i>Heterodera graminis</i> Stynes, 1971	Cyst nematode				2												2
<i>Heterodera humuli</i> Filip'ev, 1934	Cyst nematode				1												1
<i>Heterodera schachtii</i> A Schmidt, 1871	Cyst nematode		2														2
<i>Heterodera trifolii</i> Goffart, 1932	Cyst nematode				1												1
<i>Globodera</i> Skarbilovich, 1959	Cyst nematode	3	1		33											1	38
<i>Globodera rostochiensis</i> (Wollenweber, 1923) Behrens, 1975	Potato Cyst Nematode	2	1		18	2	4										27
<i>Cactodera</i> Krall & Krall, 1978	Cyst nematode				14												14
<i>Punctodera</i> Mulvey & Stone, 1976	Cyst nematode				1												1
<i>Meloidogyne</i> Goeldi, 1892	Root-knot nematode	2			1	8	8	10	2	4	1	1	5	4	3		49
<i>Meloidogyne acronea</i> Coetzee, 1956	Root-knot nematode										1						1
<i>Meloidogyne arenaria</i> (Neal, 1889) Cobb, 1890	Root-knot nematode		1								1						2
<i>Meloidogyne chitwoodi</i> Golden, O'Banon, Santo & Finley, 1980	Root-knot nematode													1	3		4
<i>Meloidogyne enterolobii</i> Yang & Eisenback, 1983	Root-knot nematode														1		1
<i>Meloidogyne hapla</i> Chitwood, 1949	Root-knot nematode									3					1		4
<i>Meloidogyne incognita</i> (Kofoid & White, 1919) Chitwood, 1949	Root-knot nematode	1			3	3	1	12	4	7	1		5	2	1		40
<i>Meloidogyne javanica</i> (Treub, 1885) Chitwood, 1949	Root-knot nematode				3	5	2	13	3	2	1	2	1	1	3		36
Family Criconematidae																	
<i>Hemicriconemoides brachyurus</i> (Loos, 1949) Chitwood & Birchfield, 1957	Sheathoid nematode+					1									1		2
<i>Mesocriconema</i> Andrassy, 1965	Ring nematode					2	2	2					1				7
<i>Mesocriconema obtusicaudatum</i> (Heyns, 1962) Loof & De Grisse, 1989	Ring nematode					2							2	1	1		6
<i>Mesocriconema surinamense</i> (De Grisse & Maas, 1970) Loof & De Grisse, 1989	Ring nematode							1								1	2
<i>Mesocriconema azania</i> (Van den Berg, 1979) Loof & De Grisse, 1989	Ring nematode							1									1
<i>Mesocriconema sphaerocephalum</i> (Taylor, 1936) Loof & De Grisse, 1989	Ring nematode					4	7	12	1	3		1	6		1		35
<i>Mesocriconema xenoplax</i> (Raski, 1952) De Grisse & Loof, 1965	Ring nematode				1	2		1					1				5
<i>Criconemoides parvus</i> Raski, 1952	Ring nematode					1	1	2							3	1	8
<i>Criconema</i> Hofmänner & Menzel, 1914	Ring nematode	1	1			1	1								2		6
<i>Criconema corbetti</i> (De Grisse, 1967) Raski & Luc, 1985	Ring nematode														1	1	2
<i>Criconema mutabile</i> (Taylor, 1936) Raski & Luc, 1985	Ring nematode		1	1		3	3	4		1		1	3	1		3	21

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<i>Hemicycliophora</i> de Man, 1921	Sheath nematode							1				1		2	1		5
<i>Hemicycliophora demani</i> Edward & Rai, 1971	Sheath nematode											1					1
<i>Hemicycliophora epicharoides</i> Loof, 1968	Ring nematode							1								1	2
<i>Hemicycliophora typica</i> de Man, 1921	Ring nematode	1				5	3								1		10
Family Tylenchulidae																	
<i>Paratylenchus</i> Thorne, 1949	Pin nematode	1													4		5
<i>Paratylenchus projectus</i> Jenkins, 1956	Pin nematode	1															1
<i>Trophotylenchus</i> Raski, 1957	-				1												1
Family Tylenchidae																	
<i>Tylenchus</i> Bastian, 1865	-			1	2	8						1		1			13
Family Trichodoridae																	
<i>Nanidorus</i> Siddiqi, 1974	Stubby-root nematode					1										1	2
<i>Nanidorus minor</i> (Colbran, 1956) Siddiqi, 1974	Stubby-root nematode	1	1	2	3	7	4	9	2	3		3	4	1	1		41
<i>Paratrichodorus</i> Siddiqi, 1974	Stubby-root nematode	1				3	1	5		2		1	1	4			18
<i>Paratrichodorus lobatus</i> (Colbran, 1965) Siddiqi, 1974	Stubby-root nematode			2		3		2	1			2					10
<i>Paratrichodorus porosus</i> (Allen, 1957) Siddiqi, 1974	Stubby-root nematode					1	1							1			3
Family Longidoridae																	
<i>Longidorus</i> Micoletzky, 1922	Needle nematode			1		2	3								2		8
<i>Longidorus pisi</i> Edward, Misra & Singh, 1964	Needle nematode					3	1	4	2	1		1	4	2			18
<i>Paralongidorus hooperi</i> Heyns, 1966	Needle nematode					2											2
<i>Xiphinema</i> Cobb, 1913	Dagger nematode	2	1			1	3	2				2		1	2		14
<i>Xiphinema diffusum</i> Lamberti & Blevé-Zacheo, 1979	Dagger nematode						1										1
<i>Xiphinema elongatum</i> Schuurmans Stekhoven & Theunissen, 1938	Dagger nematode		1					1									2
<i>Xiphinema ornativulvatum</i> Kruger & Heyns, 1987	Dagger nematode							1							1		2
<i>Xiphinema vanderlinde</i> Heyns, 1962	Dagger nematode					1	1		1					2			5
<i>Xiphinema variabile</i> Heyns, 1966	Dagger nematode					1	1										2
<i>Xiphinema vitis</i> Heyns, 1974	Dagger nematode									1							1
Family Tylencholaimidae																	
<i>Xiphinemella</i> Loos, 1950	-								1			1					2

For more information and references contact Dr Mariette Marais at MaraisM@arc.agric.za.

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