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Community and trophic structure of soil nematodes associated with *Vitis* spp. in Austria

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A survey of nematodes in seven Austrian vineyards was carried out from a faunistic and ecological point of view. The results provide information on the nematode composition at the level of taxa, life strategies and feeding types.
Mean abundances of nematodes ranged from 214–671 individuals × 100g–1 soil, and a total of 58 genera within 36 families were found. Shannon Index (3.41 ± 0.24) Simpson index (0.86 ± 0.04), evenness (0.76 ± 0.04), frequencies of c-p categories, and trophic groups were similar at all sites. Plant-parasitic nematodes were the dominant feeding type, followed by bacterial feeders, fungivores, omnivores, predators, and animal parasites. Helicotylenchus, Tylenchorhynchus, Pratylenchus, Mesocriconema, and Xiphinema were the most common plant-parasitic genera in the investigated Austrian vineyards.

HOSCHITZ M., 2004: Gemeinschaftsstruktur und trophische Zusammensetzung von mit *Vitis* spp. assoziierten Bodennematoden in Österreich.
In sieben österreichischen Weingärten wurde die Nematodenfauna von einem faunistischen und ökologischen Gesichtspunkt untersucht. Die gewonnenen Daten liefern Informationen über die Zusammensetzung der Nematodengemeinschaft, deren Lebensstrategie- und Ernährungstypen.
Die mittleren Dichten der Nematoden lagen in den untersuchten Weingärten zwischen 214–671 Individuen pro 100 g Erde. Insgesamt konnten 58 Nematodengattungen aus 36 Familien identifiziert werden. Der Shannon Index (3.41 ± 0.24), der Simpson Index (0.86 ± 0.04), Evenness (0.76 ± 0.04) und die Häufigkeit der c-p Kategorien und der trophischen Gruppen waren an den Standorten annähernd gleich. Von den gefundenen Ernährungstypen erwiesen sich die pflanzenparasitären Nematoden als die dominante Gruppe, gefolgt von den Bakterienfressern, Pilzhyphensaugern, Allesfressern, Räubern und Tierparasiten. Innerhalb der pflanzenparasitären Nematoden wurden die Gattungen *Helicotylenchus, Tylenchorhynchus, Pratylenchus, Mesocriconema,* und *Xiphinema* am häufigsten in den untersuchten österreichischen Weingärten gefundenen.

Keywords: nematode community, vineyards, Austria.

Introduction

Nematodes are the most numerous soil-dwelling animals in nearly all natural and agricultural soils. On the one hand some taxa of nematodes are parasites of plants and few of these are also a serious threat to vineyards worldwide. Nematode feeding can cause direct damage by stopping or changing root growth, killing plant tissue, and by removing plant nutrients. In addition to direct damage caused by feeding, some nematodes transmit virus diseases of grapevines such as Grapevine Fanleaf Virus (HEWITT et al. 1958), or by increasing the severity of other plant diseases (DECKER 1981). One the other hand most of the soil nematode species actually have beneficial roles in ecosystem processes. They are free living, feeding on bacteria, fungi, or other microscopic animals and are therefore important components in decomposition processes and nutrient cycling (INGHAM ET AL. 1985, NEHER 1999). Predaceous nematodes can even control pests by preying on plant-parasitic nematodes (INGHAM et al. 1985). In the last centuries nematodes have been found to posses attributes potentially making them useful as indicators for understanding ecosystem functioning (BERNARD 1992). They reflect ecosystem parameters such as ecosystem development (BONGERS 1990), changes in land use (FRECKMAN & ET-

TEMA 1993, YEATES & BIRD 1994), and stability and quality of agricultural soils (NEHER & CAMPBELL 1994). However, most research on nematodes in vineyards has been focused on important grapevine parasitic nematodes (FERRIS 1976, KLINGER & ZWICKY 1981, KOTCON 1990, PINKERTON et al. 1999, TIEFENBRUNNER 1999, GANGL & TIEFENBRUNNER 2000, REDL et al. 2000, BELAIR et al. 2001) but only little is known about nematode diversity, their role in vineyard soils, and the effects of agricultural management on their assemblages (MANACHINI 2001).

The objectives of this survey were to: (1) investigate the taxonomic diversity of free-living and plant-parasitic nematodes present in selected vineyards of Austria, (2) obtain information about their community structure and functional diversity, and (3) identify the genera/species of potential pathogenic nematodes on *Vitis* spp. in Austria.

Material and Methods

Study sites

Soil samples were collected in the years 2001 and 2002 from June to August. Seven vineyards situated in the regions of Lower Austria, Burgenland, and Styria were investigated. For detailed site descriptions and soil parameters see Table 1.

Nematode sampling, preparation, and identification

In all, soil of 102 rootstocks chosen by randomized selection were sampled. Soil samples (especially adhering soil of the hair roots) were dug from the upper 50 cm around each rootstock with a shovel and pooled to form a bulk sample of about 500 g. The sample of each rootstock was carefully mixed by hand at the laboratory and an aliquot of 100 g soil was taken for nematode analysis. Nematodes were extracted by the Ostenbrink elutriation method (OOSTENBRINK 1954) followed by the Baermann Method (BAERMANN 1917), fixed in 4% formalin, transferred to glycerin and subsequently mounted in bulk on glass slides, identified to genus/species level and counted at the family level. Differentiation between Tylenchidae and Anguinidae (the latter only represented by the genus *Ditylenchus)* caused problems during counting. Therefore, these two families were combined in the group Tylenchidae + Anguinidae, were the family Tylenchidae was in the vast majority. Taxonomic work was performed on the basis of the classification of BONGERS (1988).

Table 1: Soil characteristics and grapevine/rootstock varieties of investigated sites.

region/site	Grapevine variety rootstock variety	soil type	Green soil cover	pH ($CaCl_2$)	water content (%)
Lower Austria/Retz (RET)	St. Laurent/ Kober 5BB und 5C	Haplic Chernozem	yes	7.1	17.7
Lower Austria/Großmugl (GRO)	Zweigelt/ Kober 5BB	Calcaric Anthrosol	yes	7.4	9.7
Burgenland/ Gols (GOL)	Zweigelt/ Kober 5BB	Gleyic Chernozem	no	7.4	10.1
Burgenland/ Frauenkirchen (FRA)	Zweigelt/ Kober 5BB	Haplic Chernozem	no	7.5	10.2
Styria/ Straden (STR)	Muskateller, Sauvignon Blanc/SO4	Cambisol	yes	6.4	14.0

region/site	Grapevine variety rootstock variety	soil type	Green soil cover	pH ($CaCl_2$)	water content (%)
Burgenland/ Deutschschützen (DEU)	Zweigelt/ Kober 5BB	Haplic Planosol	yes	5.5	14.9
Burgenland/ Eltendorf (ELT)	Ottello (own-rooted)	Cambisol	yes	6.2	12.5

Data analysis

Diversity of nematodes for each vineyard was measured by the Simpson Index (SIMPSON 1949), Shannon-Wiener Index (KREBS 1989) and the corresponding evenness (MAGURRAN 1988). In addition to the diversity indices the maturity index (MI) after BONGERS (1990) was calculated. Taxonomic units were classified into groups with different life strategies, from colonizers (r-strategists s. l.) to persisters (K-strategists s. l.) and each was given a colonizer-persister (c-p) rank value from 1 (= colonizers) to 5 (= persister). Plant-parasitic nematodes (PPI, plant parasitic index) were calculated separately, according to the advice of BONGERS (1990). The MI is calculated as the weighted mean of the individual c-p values of the constituent taxa in a given sample: MI = $\xi v(i)\ f(i)$, where v(i) is the c-p value assigned to the i-th taxon, and f(i) is the frequency of the i-th taxon in the community.

Nematode taxa were assigned to seven trophic groups, according to YEATES et al. (1993): bacterivore, fungivore, plant-parasite, animal predator, omnivore, eukaryote feeders, and animal parasites.

Results

A total of 45.302 nematode specimens were counted at the family level. Fifty-eight genera were identified from seven sites, representing thirty-six families in seven orders. A taxonomical list of nematodes is presented in table 2. The number of families ranged from 21 to 30 at the seven sites. Nematode mean abundances ranged from 213.5 ± 109.0 to 671.4 ± 286.3 individuals × 100 g^{-1} soil and were lower by a factor of about 2–3 at the sites of Burgenland (GOL, FRA, DEU, ELT) than at the sites situated at Lower Austria (RET, GRO) and Styria (STR). Detailed information about the abundance of each nematode family and a grouping according their feeding habits is given in table 3.

In all, the nematofauna found in the vineyard soils occupied six trophic groups and was dominated by plant-parasitic nematodes. The latter amounted to approximately fifty percent of the total nematode community, followed by bacterial feeders, fungivores, omnivores, predators, and insect parasites (fig. 1). Nematodes of the plant-parasitic families Hoplolaimidae, Dolichodoridae, Pratylenchidae, and Tylenchidae were found at all sites. Cricronematidae were collected in 86%, Longidoridae in 71%, Paratylenchidae in 42%, and Psilenchidae in 28% of the vineyards. There was a high variation in population density (especially, Paratylenchidae) between and also within sites (table 2). A summing up of the population densities from all sites showed *Helicotylenchus* (Fam. Hoplolaimidae) as the most frequent and most abundant genera in Austrian vineyards. The species mainly found was *H. digonicus* which represented about twenty five percent of the whole plant-parasitic nematode community. *Paratylenchus* sp. was the second abundant species, followed by *Xiphinema vuittenezi, Pratylenchus* spp., *Mesocriconema xenoplax, Longidorus attenuatus*, and *Psilenchus* sp. The group Tylenchidae + Anguinidae (represented by 5 genera) amounted to 29% and the family Dolichodoridae (represented by at least 3 genera) to 13% of the whole group of plant-parasitic nematodes (fig. 2). The most abundant not parasitic free-living nematodes which were found at all vineyards are as follows: Among the bacteria feeders, the families Cephalobidae and Rhabditidae, the former contributed 13.2%, the latter 5.3% of the nematofauna. The fungivorous nematodes *Aphelenchus avenae* with 10.8% followed by *Aphelenchoides* spp. with 1.3%, the omnivorous families Aporcelaimidae (3.5%), Thornenematidae (2.1%), and Qudsianematidae (2.0%), and the predatory family Mononchidae (1.3%). Eukaryote feeders and insect parasites were found with abundances less than 0.4%.

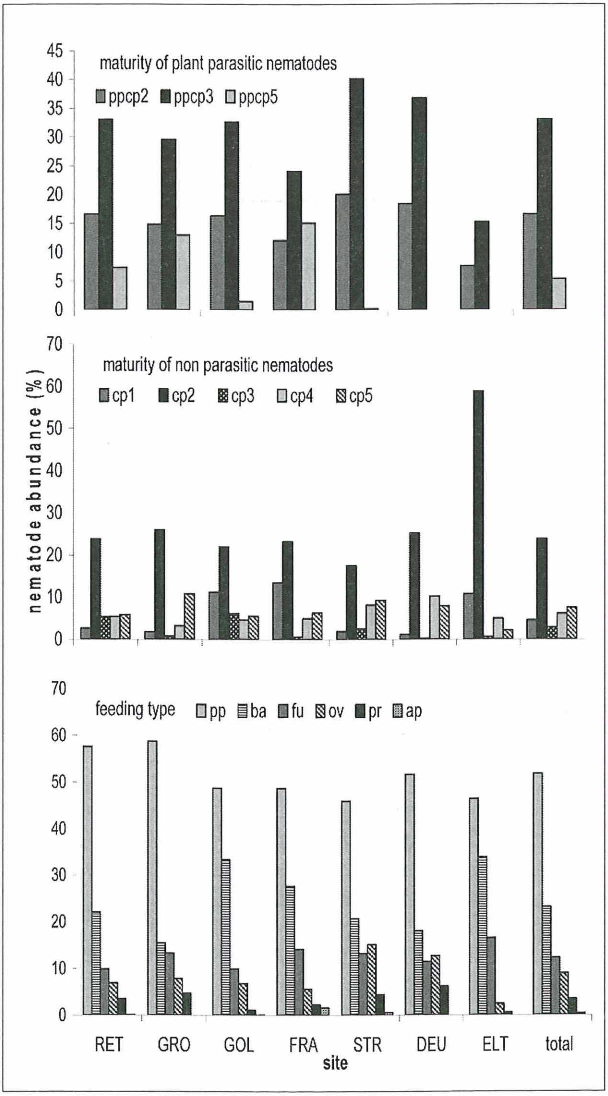

Fig. 1. Frequencies of nematodes grouped according their feeding types (after Yeats et al. 1993) and and according their life strategies (after Bongers 1990). pp, plant-parasites; ba, bacterivores; fu, fungivores; ov, omnivores; pr, animal predators; ap, animal parasites.

Shannon-Wiener Index, Simpson Index, and Evenness were similar at all sites, maturity indices also showed only slight deviation from a calculated mean value for MI (2.6 ± 0.4), and PPI (2.8 ± 0.4), respectively (table 2). Additionally to the calculation of the maturity indices, a grouping of nematodes according their life-strategies was done. At all sites non parasitic nematodes with c-p value 2 dominated, whereas nematodes with c-p value 3 dominated within the plant-parasitic nematodes (fig. 1).

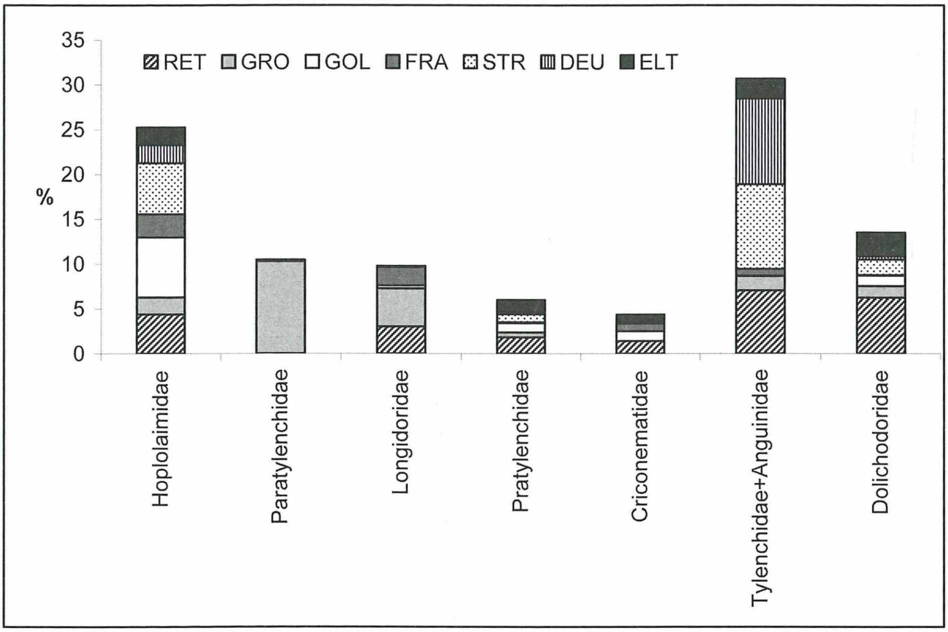

Fig. 2. Abundance of plant-parasitic nematode families sampled at the seven sites. Subdivided bars indicate percentage of nematode genera/families of each site.

Discussion

In the current study the whole nematofauna associated with grapevine (*Vitis* spp.) was recorded. Many findings – regarding the taxa of plant-parasitic nematodes – were consistent with results from other surveys of vineyards (SCOTTO LA MASSÉSE 1988, PINKERTON et al. 1999, TIEFENBRUNNER 1999, GANGL & TIEFENBRUNNER 2000, BELAIR et al. 2001, MANACHINI 2001) and orchards (KOTCON 1990, WANG et al. 2001). *Xiphinema* spp., *Mesocriconema* spp., *Pratylenchus* spp., *Paratylenchus* spp. and *Helicotylenchus* spp. of *Vitis* spp.

Table 2. Nematode taxa: Orders, families, genera/species, c-p values of genera (according to Bongers 1990), and feeding types (according to Yeates et al. 1993) found in Austrian vineyards. ba=bacterivore, fu=fungivore, pp=plant parasite, pr=animal predator, ov=omnivore, ap= animal parasite, eu=eukaryote feeder

order	family	*genus/species*	c-p value	feeding typ
ARAEOLAIMIDA	Plectidae	*Plectus* spp.	2	ba
	Rhabdolaimidae	*Rhabdolaimus* sp.	3	ba
CHROMODORIDA	Achromodoridae	*Achromadora* sp.	3	eu
DORYLAIMIDA	Alaimidae	*Alaimus* sp.	3	ba
	Anatonchidae	*Miconchus* sp.	4	pr
	Aprocelaimidae	*Aporcelaimellus obtusicaudatus* (Bastian, 1865)	4	pr,
		Aporcelaimellus paraobtusicaudatus (Micoletzky, 1922)	4	pr,
		Paraxonchium sp.	4	pr, ov
	Belondiridae	*Dorylaimellus* sp.	5	fu, pp
	Diphterophoridae	*Diphtherophora* sp.	3	fu
	Discolaimidae	*Discolaimium* sp.	5	pr
		Discolaimus sp.	5	pr
	Leptonchidae	*Dorylaimoides* sp.	4	ov
		Tylencholaimus sp.	4	fu
	Longidoridae	*Longidorus attenuatus* (Hooper, 1961)	5	pp
		Xiphinema diversicaudatum (Micoletzky, 1927)	5	pp
		Xiphinema vuittenezi (Luc & al., 1964)	5	pp
	Mononchidae	*Clarkus* sp.	4	pr
		Mylonchulus sp.	4	pr
	Nordiidae	*Enchodelus* sp.	4	ov, eu
		Longidorella macramphis (Altherr, 1950)	4	pp
		Pungentus sp.	4	ov, pp, pr
	Nyoglaimidae	*Nygolaimus trophurus* (Heyns, 1968)	5	pr
	Qudsianematidae	*Dorydorella* sp.	4	ov
		Epidorylaimus sp.	4	ov
		Kochinema sp.	4	ov
		Microdorylaimus sp.	4	ov
	Thornenematidae	*Ecumenicus* sp.	5	ov
		Mesodorylaimus sp.	5	ov
		Prodorylaimus sp.	5	ov
ENOPLIDA	Aulolaimidae	*Aulolaimus oxycephalus* (de Man, 1880)	3	ba
	Onchulidae		3	pr,
	Prismatolaimidae	*Prismatolaimus* sp.	3	ba
	Tripylidae	*Tripyla filicaudata* (de Man, 1880)	3	pr
MONHYSTERIDA	Monhysteridae	*Monhystera* sp.	4	ba
RHABDITIDA	Cephalobidae	*Acrobeles ciliatus* (Linstow, 1877)	2	ba
		Acrobeloides tricornis (Thorne, 1925)	2	ba
		Cephalobus sp.	2	ba
		Chiloplacus propinquus (de Man, 1921)	2	ba
		Eucephalobus/Heterocephalobus sp.	2	ba
		Wilsonema sp.	2	ba
	Panagrolaimidae	*Panagrolaimus* sp.	1	ba
	Rhabditidae	*Protorhabditis oxyuroides* (Sudhaus, 1974)	1	ba
	Strongyloididae	*Steinernema* sp.	/	ap
	Teratocephalidae	*Teratocephalus* sp.	3	ba

order	family	*genus/species*	c-p value	feeding typ
TYLENCHIDA	Aphelenchoidae	*Aphelenchus avenae* (Bastian, 1865)	2	fu
		Paraphelenchus pseudoparietinus (Micoletzky, 1922)	2	fu
	Aphelenchoididae	*Aphelenchoides bicaudatus* (Imamura, 1931)	2	fu
		Aphelenchoides composticola (Franklin, 1957)	2	fu
		Aphelenchoides subtenuis (Cobb, 1926)	2	fu
	Criconematidae	*Mesocriconema rustica* (Micoletzky, 1915)	3	pp
		Mesocriconema xenoplax (Raski, 1952)	3	pp
	Dolichodoridae	*Trophurus* sp.	3	pp
		Tylenchorhynchus sp.	3	pp
	Hoplolaimidae	*Helicotylenchus digonicus* (Perry, 1959)	3	pp
		Helicotylenchus pseudorobustus (Steiner, 1914)	3	pp
		Helicotylenchus vulgaris (Yuen, 1964)	3	pp
	Paratylenchidae	*Paratylenchus projectus* (Jenkins, 1956)	2	pp
	Pratylenchidae	*Pratylenchus* sp.	3	pp
		Pratylenchus neglectus (Rensch, 1924)	3	pp
	Psilenchidae	*Psilenchus* sp.	2	pp
	Tylenchidae + Anguinidae	*Ditylenchus* sp.	2	pp, fu
		Filenchus sp.	2	pp
		Lelenchus sp.	2	pp
		Malenchus sp.	2	pp

Table 3: Mean abundance ± SD (individuals × $100g^{-1}$ soil) over the year 2001 and 2002, number, diversity indices, and MI and PPI index of soil nematode families and trophic groups.

	RET n = 18	**GRO** n = 12	**GOL** n = 12	**FRA** n = 24	**STR** n = 18	**DEU** n = 6	**ELT** n = 12
plant parasites							
Criconematidae	22.8 ± 16.7		17.6 ± 28.2	13.9 ± 20.6	1.8 ± 3.0	0.8 ± 1.2	13.3 ± 13.0
Dolichodoridae	100.6 ± 154.3	21.1 ± 33.6	18.5 ± 14.3	0.8 ± 2.7	28.2 ± 19.1	5.5 ± 1.9	42.9 ± 29.1
Hoplolaimidae	70.8 ± 33.4	30.3 ± 27.9	107.8 ± 185.7	41.7 ± 58.4	91.6 ± 56.8	32.3 ± 18.1	31.6 ± 20.1
Longidoridae	48.4 ± 37.0	68.7 ± 51.9	5.2 ± 5.6	33.0 ± 27.6	1.8 ± 2.8		
Paratylenchidae	0.7 ± 1.5	165.6 ± 478.0		0.9 ± 2.9			1.3 ± 1.7
Pratylenchidae	29.3 ± 55.0	8.8 ± 10.1	17.0 ± 9.0	1.5 ± 2.3	14.4 ± 10.5	3.8 ± 3.8	21.8 ± 12.5
Psilenchidae	0.8 ± 1.4					0.2 ± 0.4	
Tylenchidae + Anguinidae	113.3 ± 68.8	25.9 ± 29.3	0.9 ± 1.6	11.9 ± 11.6	152.1 ± 69.7	153.7 ± 135.0	36.0 ± 20.6
bacteriovorous							
Achromodoroidae	10.4 ± 15.6		0.8 ± 1.3				
Alaimidae	4.2 ± 6.6		9.0 ± 6.9	7.9 ± 5.2	25.4 ± 18.7	2.7 ± 1.9	5.9 ± 4.4
Aulolaimidae	16.1 ± 10.8	3.8 ± 4.5			1.1 ± 1.8		
Cephalobidae	83.0 ± 57.0	68.9 ± 51.4	40.2 ± 19.3	19.7 ± 16.3	58.8 ± 27.7	56.0 ± 49.6	71.3 ± 38.5
Monhysteridae					0.5 ± 1.5		
Panagrolaimidae	2.4 ± 3.7	0.3 ± 1.2		0.5 ± 1.8	13.1 ± 17.7	1.7 ± 1.6	3.8 ± 3.2
Plectidae	8.3 ± 11.5	2.1 ± 2.5	3.9 ± 4.8	0.7 ± 1.1	6.8 ± 5.5	4.7 ± 3.1	5.3 ± 3.4
Prismatolaimidae	5.9 ± 7.4		20.9 ± 32.5	1.4 ± 4.0	3.1 ± 7.0		0.8 ± 1.3
Rhabditidae	15.2 ± 9.3	9.1 ± 11.8	40.0 ± 33.2	28.8 ± 24.7	3.7 ± 3.5	3.0 ± 5.3	19.8 ± 18.1
Rhabdolaimidae	2.5 ± 6.6						
Teratocephalidae	0.3 ± 0.8						
Tripylidae					12.8 ± 18.6	0.7 ± 1.2	0.3 ± 0.7

	RET n = 18	GRO n = 12	GOL n = 12	FRA n = 24	STR n = 18	DEU n = 6	ELT n = 12
fungivorous							
Aphelenchoidae	60.4 ± 61.3	59.5 ± 56.7	33.7 ± 19.1	24.2 ± 10.6	79.3 ± 47.2	29.2 ± 15.5	45.8 ± 19.9
Aphelenchoididae	5.4 ± 11.4	6.9 ± 10.3	0.4 ± 1.0	6.0 ± 4.0	4.1 ± 4.1	13.7 ± 14.5	6.4 ± 9.0
Belondiridae				0.0 ± 0.2			
Diphterophoridae					5.4 ± 3.7		
Leptonchidae	0.2 ± 0.7	6.3 ± 18.0				0.7 ± 0.8	
omnivorous							
Aprocelaimidae	24.9 ± 14.9	28.7 ± 16.6	13.3 ± 5.5	6.6 ± 5.3	24.6 ± 27.8	15.0 ± 8.4	3.3 ± 3.4
Nordiidae	1.8 ± 3.3	0.9 ± 2.2	6.1 ± 4.3	0.4 ± 0.8	3.9 ± 3.3	2.5 ± 2.9	
Qudsianematidae	12.0 ± 9.6	9.3 ± 29.9	0.6 ± 1.2	2.7 ± 4.3	14.9 ± 10.4	21.7 ± 15.7	3.3 ± 2.4
Thornenematidae	7.7 ± 11.2	3.9 ± 8.4	3.5 ± 2.8	2.4 ± 4.0	52.6 ± 37.1	9.0 ± 4.2	1.2 ± 1.1
animal predation							
Anatonchidae	0.3 ± 1.0				10.8 ± 8.6	1.5 ± 1.5	0.9 ± 1.1
Discolaimidae	6.0 ± 7.5	24.9 ± 45.2	2.9 ± 2.1	4.9 ± 3.2			
Mononchidae	17.4 ± 11.1	0.6 ± 1.7	1.0 ± 1.5		14.8 ± 11.7	12.8 ± 4.2	0.8 ± 1.5
Nyoglaimidae					2.2 ± 6.6	8.7 ± 9.5	0.3 ± 0.9
Oncholidae						0.5 ± 1.2	
animal parasites	0.3 ± 1.4		0.2 ± 0.6	3.6 ± 15.3	3.1 ± 7.3		
total	**671.4 ± 286.3**	**545.5 ± 635.0**	**343.3 ± 196.0**	**213.5 ± 109.0**	**630.8 ± 212.7**	**380.2 ± 226.0**	**316.0 ± 96.8**
no. of families	30	21	22	23	27	24	22
Shannon Index H′ ($\log_2$)	3.77	3.29	3.30	3.51	3.61	3.05	3.36
Simpson (1-D)	0.90	0.85	0.85	0.89	0.88	0.79	0.87
Evenness J′ ($\log_2$)	0.78	0.76	0.75	0.79	0.77	0.67	0.77
MI	2.6	2.8	2.3	2.3	3.1	2.9	2.1
PPI	3.0	2.8	3.1	3.5	2.5	2.2	2.8

Among the nine genera of plant-parasitic nematodes found in this survey, the species *Mesocriconema xenoplax* has been reported to cause economic loss in other grape growing areas of the world (BIRD & RAMSDELL 1985, RAMSDELL et al. 1996, PINKERTON et al. 1999). In Austria *M. xenoplax* was reported by WEISCHER (1961), and EL SHAFEEY (1993). *M. xenoplax* is an ectoparasite on root tips or along more mature roots. Feeding causes local darkening of root tissue and results in reduction of feeder roots, the ability to withstand stress, and nutrient uptake (KLINGER & GERBER 1972, SANTO & BOLANDER 1977). PSCHEIDT (1997) reported a reduction of grape yields in Washington at a number of 120 individuals × 100 g^{-1} soil and in pot experiments, top and root growth of Concord grape were suppressed about 50% by 133 individuals per 100 cm^3 soil (SANTO & BOLANDER 1977). Beside *M. xenoplax*, the detected genus *Xiphinema* has also the potential to effect wine growth. The species mainly found in the present study was *Xiphinema vuittenezi*, a widespread nematode in Austria (EL-SHAFEEY 1993, TIEFENBRUNNER 1999, GANGL & TIEFENBRUNNER 2000). The genus *Xiphinema* was detected in 71 percent of the vineyards, but *X. index*, the vector of the Grape Fan Leaf Virus was not detected. In pot experiments ANWARE & VAN GUNDY (1989) found that root length of grape was retarded by 44% by 25 virus-free *X. index* per 100 cm^3 soil. Unfortunately, the lack of information on the pathogenicity of *X. vuittenzi* and the other detected ectoparasitc nematodes, particular found in large numbers in the soil around the roots, dose not allow predictions about their effects on grape vine. However, striking high abundances (up to 680 individuals × 100 g^{-1} soil) and the presence at all investigated vineyards would cause *Helicotylenchus* spp. to candidates of further investigations regarding their potential pathogenicity.

Comparison of the whole nematode community – including all feeding types – found in Austrian vineyards with those of other regions is difficult because most studies have been focused on parasitic nematodes, only. Studies of vineyard soils including non-parasitic nematodes are rare (FERRIS & MC KENRY 1976, MANACHINI 2001). However, in this study diversity indices (H′=3.05–3.77) and the maturity indices (MI=2.1–3.1) were high, compared with data from vineyards in Italy, where H′ ranged between 0.89 and 1.09 and MI between 1.6 and 1.9, respectively (MANACHINI 2001). In contrast to most other agro ecosystems and also to the vineyards studied by MANACHINI (2001), were bacterial feeders are the dominant feeding group, plant-parasitic nematodes predominated (>50%) in the soil of the investigated Austrian vineyards. The dominance of parasitic nematodes with cp-value 3 on the one hand and the low abundance of bacterial feeders with cp-value 1 on the other hand, explain the high maturity indices, indicating a stable situation for nematodes in the investigated vineyards

In general, comparison of nematode communities of habitats located in different geographical regions or even in the same region is problematic because nematode diversity may depend on so many factors like, soil type, biotic factors, moister, fertilization and tillage; factors, affecting also the pathogenicity and distribution of each plant-parasitic nematode (FERRIS & MC KENRY 1976). In addition to these problems, data on damage thresholds for most plant-parasitic nematode species and grapevine varieties, grown under different conditions, are rare. Nevertheless, investigations on the structure of nematode communities on a regional basis is a very useful tool to evaluate risks caused by nematodes, especially when planting or replanting vineyards.

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